THE
STEEL SQUARE HANDBOOK AND INSTRUCTOR

BY

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For the use of Students, Builders and Journeymen Carpenters, embodying a series of problems covering the ordinary practice of roof construction in a complete and practical system, copiously illustrated, fully described and explained. Also extensive tables of stairs and rafters of the most up-to-date and universal nature.

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Preface

The objects of this work are to introduce the study of the "Steel Square" in such easy stages as to be understood by any carpenter, and to bring a system of roof and stair building within reach of everyone in the trade.

This course of lessons has been tried out, revised, and added to every year until it has attained the complete condition in which it now stands, being based on practical knowledge, proved in actual practice, and having stood the test of much expert criticism.

The system is dealt with in a connected routine of progressive steps, as practised by operative carpenters, the explanations and rules being confined to as few words as can possibly convey the necessary information.

The tables will merely require to be tested and their value and convenience will assuredly be realized.

The assistance of the gentlemen here named has been of very material value in compiling this treatise.

S. VAN RAALTE, Architect
J. M. TURNER, Draughtsman
T. RYAN, Carpenter

And though little or nothing in this book may be said to be a direct copy of the works of our old friend, Mr. Fred T. Hodgson, still many of the truths embodied here have been learned from him who may well be called the father of the steel square science.

Introductory Remarks by the Author

This work is intended for the use of classes and is arranged in a series of progressive steps, each one a complete and definite problem.

Equipped with an understanding of all these, a carpenter will be the possessor of a complete system of roof construction, and a thorough working knowledge of the subject. The tables which are given will be found valuable in giving the measurements required, and will save much time and labor.

But not alone in that capacity will they be valuable, but for those who are well versed in the work, they will answer as a check and will help to relieve much burdensome responsibility.

The problems which are treated in this course will be considered as passing through three stages, and it will be seen as we proceed, that there is a distinct system of division into three all through the practice of laying out work.

Strange as it may seem, the square is used to perform three principal functions, which are, first: Finding Lengths; second: Marking Angles; third: For ascertaining proportions.

The three stages into which the work is divided will bear the following names:

1st. The Statement
2nd. The Essentials
3rd. The Formula

To explain the meaning of these terms it will be well to take them in the order in which they occur in the actual work.

1st. The statement includes that data, information, or measurements which must be given before it can be said that the Framer has received an order to build a roof.

2nd. When the statement has been given, the Framer can not apply the square to the scantling until he has found out, or decided, some certain points, such as the length of the rafter, the amount of the splay, etc., which will be defined in each problem as we proceed.

3rd. The formula includes those positions of the square, measurements, etc., which are made use of in the actual work of laying out the rafters.

Having thus settled on a plan of action, we will proceed to apply it to the following problems which will cover all the principal operations in ordinary roof construction.

The arrangement of this course in a series of progressive steps, is the result of years of study and practical work, and though no doubt many improvements can yet be made, still it can be confidently stated that any man who can perform all the operations herein described is beyond all doubt a master of the art.

This set of problems will be found to contain all the principal operations in steel square practise and will be treated in the following order:

(1) The common rafter.
(2) The hip rafter for even pitched roofs.
(3) The jack rafters for even pitched roofs.
(4) Valley rafters for even pitched roofs.
(5) Pediments, as attached to roofs of any pitch.
(6) Valley rafters for intersecting roofs of different pitches.
(7) Hip rafters for unequal pitched roofs.
(8) Hip roofs of unequal pitch having even cornice.
(9) Plain stairs, newel posts and stair winders.

This list of problems does not correspond with the list of lessons, as it has been found that some problems require more than one lesson.

Some problems require much more description than others, therefore, to read the lectures as given, will assist to a better understanding of the three stages of the work.

In some of the problems it has been found, (by practice in teaching,) that it is well to divide the study in two or more lessons.

This has been done for this reason, that if the student masters one idea at each lesson he is making good progress, and if he makes good on one lesson each week during the course, he has performed an unusual feat in the studying line.

To accomplish this it will be necessary for him to work all the examples given, and also to practise on actual material, so that at each stage he will be able to perform the work that the lesson covers.

The benefit of taking this course as it has been arranged in one homogenious connection from first to last, will easily be seen by anyone who follows it through.

Many writers take isolated problems and endeavor to explain them, and though much good work has been done, and many brilliant ideas have been laid before the public, compared to which this work must occupy a humble place, still it is about as difficult to build a system out of isolated problems as it would be to take parts of several different kinds of watches and assemble them together to construct a machine for the purpose of keeping time.

One apology perhaps should be made, or rather an explanation, as it is generally considered that repetition should not occur. The reader must allow, however, that certain passages could not be complete without the repetition of what has been stated elsewhere.

The first nine sections are calculated to embody the principal problems in ordinary work and cover that which has been given as a course of instruction at the Young Men's Christian Association of Toronto for a number of years, and it is through the experience gained in this institution that this work has developed to the condition in which it now stands.

The remaining miscellaneous problems have been added for those who would go further in the matter.

The rafter and stair tables can speak for themselves; all that we ask for them is investigation, and every one who understands them will be able to judge for himself of what value they will be to him.

In conclusion allow me to give a word of advice to those who contemplate making a study of the steel square.

There are three styles of men who fail to make good—

First.—There are those who lack constructiveness; their minds are not adapted to comprehend these problems, but the men who fail on this point are few if they are sound on the other points.

Second.—Lack of concentration. This is a very large class. They are not sure of their measurements; they cannot depend upon their figures; they are not positive about their theory because they only half remember it; they only half remember it because they only half took it in; they only half took it in because they had not their attention concentrated upon it, and few there are who are absolutely free of this fault; so many valuable lives are wasted for lack of the habit of concentration.

Third.—Lack of perseverance. Among the brightest and best students there are those who fail for want of this manly qualification. Every teacher knows the slaughter that it works among all grades of ability. Men in every line of mental activity are wide awake to the fact that many singular failures are owing to the lack of good stiff backbone.

Is It Worth While.

Just show me the man who has made a study of the steel square who says it is not worth while.

Notice the men who have made a study of the steel square, how well pleased they are with their efforts if they have acquired the system.

There is not a man who is master of the art who has not paid the price, and the price has generally been many years of practical work, and many hours constantly spent in studious thought.

There is not a man of that stamp who will ever regret the time that he spent in studying the steel square.

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THE
STEEL SQUARE HANDBOOK AND INSTRUCTOR

....The...

Steel Square Hand-Book and Instructor

Section 1.

Advice to Readers.

It is seldom if ever realized that the errors that occur are in nine cases out of ten owing to the fact that the student is uncertain about his measurements.

It is a common occurrence on the buildings to find that, either the figures have been copied wrong, or that the measurements have been taken wrong, forgotten, or taken for something else.

The average man will not take a dozen measurements without having one or more wrong. He will not measure the frames in one house for a bill of sash without having mistakes in it. And yet there is nothing in it but straight measurements.

A truth is the simplest thing that exists, and it is the hardest thing to get, and it is a rare and invaluable accomplishment if a man can be positive that the measurements he has taken are correct and his figures true.

There is no line of science where incorrectness makes greater ravages than in steel square work. It limits the student to the strictly common, simple problems, and deprives him of the value that he would otherwise be to himself and his employers.

Let me suggest for those who are troubled in this way, (and they are many,) that they practise taking measurements. Say, begin with ten at a time. Take a measurement and put it down, then take two, then three, then four, and continue this practice until he can take the ten and be positive he is correct. Then increase the number discretly as his capacity will admit, and eventually he will be positive that all the measurements he takes will be correct; even as some men are constantly taking measurements and never make a mistake unless it is brought about by some very unusual circumstance. Unless a man has confidence in his measurements he will never excel in the use of the steel square. One point at a time, well impressed, will be good progress, and for this reason the exercise should contain generally only one new idea.

(Note) It will be seen that there are figures and diagrams in these plates which are not alluded to in the text. These have been used in the class work and have been allowed to remain for future use in the correspondence course.

(Note) In a work of this kind where there is so much new material, it must always be admitted that minor errors will escape notice, even though it has been checked and reviewed many times.

Therefore if any one of our readers should discover anything of this kind we would be greatly obliged if he would inform us of it and we will take this opportunity of thanking him in advance for the favor he will confer.

FIRST PRINCIPLE IN STEEL SQUARE PRACTICE.

(1.) The first thing to be considered in steel square work is to understand the principles upon which we are working, and for that purpose we should consider of what the main functions of the steel square practice consist.

(2.) Of course it is an universally accepted fact that the variety of cases in which the steel square may be used is simply beyond the capacity of any man to imagine. But though there are many minor functions, such as striking circles and ellipses, performing various calculations, etc., the main practical value of the square lies in the performing of these three operations,

(1) Marking angles.
(2) Finding lengths.
(3) Ascertaining proportions.

(3.) Of these three, the last is the least used, but is of great service in laying out jack rafters, and does some nice things for us in intersecting roofs.

(4.) The second, finding lengths, at once brings in the idea of the square as a right angled triangle, which is applied to the roof at a scale of one inch to the foot. But that function simply means this, we have a right angled triangle, with sides of stated length, as for instance in our example, we have a base line of 12′ and a rise of 5′.

(5.) To find the length of the other side, just apply the rule to the square with 12″ on the blade and 5″ on the tongue. The result will be 13″, so with that rise and run we would have a rafter 13 feet.

(6.) But at this juncture it will be well to look upon this function as just applying to the triangle; it may be for a rafter, it may be a brace or a stair string. Before we get through we will have the triangle upside-down, lying on the level, on the face of the roof, down in a hopper, or against the legs of a trestle.

(7.) So the whole of this idea is just to find the length of the sloping side of a right angled triangle.

(8.) The first of these functions is of great importance as we shall see.

How would we square the end of a board without it? And it is only the matter of laying it on the board a little differently, and you get any other angle that you require. Just turn the square to 12″ and 5″ as shown, and you have the angles for the plumb and seat cuts of a rafter for that rise and run.

FIRST PRINCIPLES

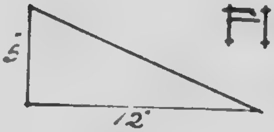


Fig 1.

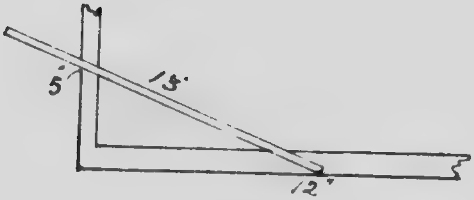


Fig 2.

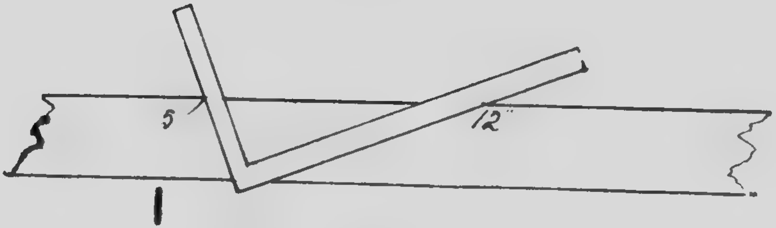


Fig 3.

No. I.

Exercise Sheet.

Base of triangle.	Perpendicular of triangle.	Sloping side of triangle.
10'	8'	12' 9 11-16"
11'	9'	14' 2 9-16"
12'	8'	14' 5"
9'	5'	10' 3 9-16"
18'	14'	22' 9 5-8"
17'	15'	22' 8"
20'	15'	25'

Throughout this book the answers will be found enclosed thus, with heavy lines. The first question has its answer stated as an example, the others are to be worked by the students.

COMMON RAFTER.

Lecture.

(1.) There are many problems which may be looked upon as more simple than the common rafter and therefore to be preferred for introductory lessons. Also there are other ways of opening the subject by lengthy explanations, and comparisons to other mathematical subjects. But the every-day practical man wants results and wants to know from the beginning what he is entitled to expect as a reward for his studies.

(2.) Therefore we feel justified in introducing one of the most striking and most valuable operations which can be performed with the steel square with the assurance that its simplicity and its strongly marked outline will render it easy of comprehension, and its definite purpose and application will be equally convincing to the student, of its sterling value.

(3.) Before stating the problem, some little explanation on a few points will be beneficial, particularly to those who are not well versed in the terms and general lay-out of roof work.

(4.) To begin with, the common rafter is that kind of rafter which is used in a plain roof where the rafters are of one pattern, a sample of which is shown in Fig. 4, Plates 2 and 3. The plain diagram of the roof is shown in Fig. 1, and the successive positions of the square in laying out are shown in (Plates 2 and 4).

(5.) In Plate 2, the roof is just the height called for above the plate. But in the roof with projection, in (Plate 3,) the pitch is the same but the actual height is increased the amount of the depth of the rafter above the plate, a to a, (Fig. 4, Plate 3).

(6.) This is a point which must be understood, as there is great confusion of ideas about this matter. Many are under the delusion that the rise of the roof is from the level of the plate to the top of the ridge. It seems impossible for some men to understand that from the level of the plate to the top of the ridge will be probably 4 to 5 inches higher than the measurement calls for. To understand this, imagine a line proceeding right up the face of the wall and up through to the surface of the roof. On this line take the distance from the top of the plate to the surface of the roof. As the roof is raised so much at the plate it must be raised the same amount at the ridge, therefore at the ridge, the roof is so much higher than the stated rise. If after the material of the roof is put in position, the ridge was only the height of the stated rise above the plate, while at the plate there still remained the excess of some inches, it is evident that the roof could not contain the pitch called for in the rise and run.

(7.) The run of the roof is half the span. The plumb cut is the perpendicular cut at the top end of the rafter. The seat cut is that which rests on the plate.

(8.) The projection is that part which overhangs the plate in Fig. 4, shown as 10 inches from the face of the wall.

(9.) The sizing is the depth of the rafter where it passes over the plate.

(10.) In this work we will constantly refer to the right angled triangle in such terms as the hip triangle, the horizontal triangle, the valley triangle, and, as in this lesson, the common rafter triangle. So for those who are not acquainted with the term it will be well to fully define what is meant. The word triangle simply means a figure with three angles.

(11.) The right angled triangle is one which has one square corner or right angle in it, and this right angle is the same no matter what length the sides are or what the other angles are, except that the term always imposes the conditions that neither of the other two angles can be as great as a right angle, and that both added together will always amount to the same as a right angle.

(12.) And now we are coming to the most vital point in the whole subject of the use of the steel square, which is, that by TAKING THE TRIANGLES AT A SCALE OF ONE INCH TO THE FOOT, THE STEEL SQUARE CONTAINS ALL THEIR ANGLES WITHIN THE DIMENSIONS OF 24' AND 16', and 18" also that by measuring from point to point on the square, we obtain the length of the third side of any one of these triangles.

(13.) In the common rafter triangle we have for the base or run, half the span of the roof, and for a perpendicular the rise of the roof. To show this, we have the gable (Fig. 1, Plate 3,) which when divided contains two triangles, one of which is shown in (Fig. 2), with the measurements of all its sides.

(14.) To obtain the length of the long side, measure across from run to rise, as shown in (Fig.6, Plate2) In this case we measure from 8 to 6, and the result comes out as 10. But no matter what the rise and run are, or whether there are odd inches, in any or all of the measurements the rule is the same, measure from run to rise for the length of the rafter.

(15.) It will be well to notice before going any further just what process we are adopting and how well it answers. In reality the length of this rafter is from 8 to 6 feet, but we are working in inches. We measure from 8 to 6 inches and we get 10 inches. The feet are in inches and the inches are in twelths with us now, for this is the scale of one inch to the foot; some framers prefer 1 ½ inches to the foot so that the eights become inches, others again use three-quarters, so that the sixteenths are inches, but the inch to the foot is generally more serviceable.

(16.) Having settled the matter of finding the length, the plumb and seat cuts will almost fall into place without effort of any kind.

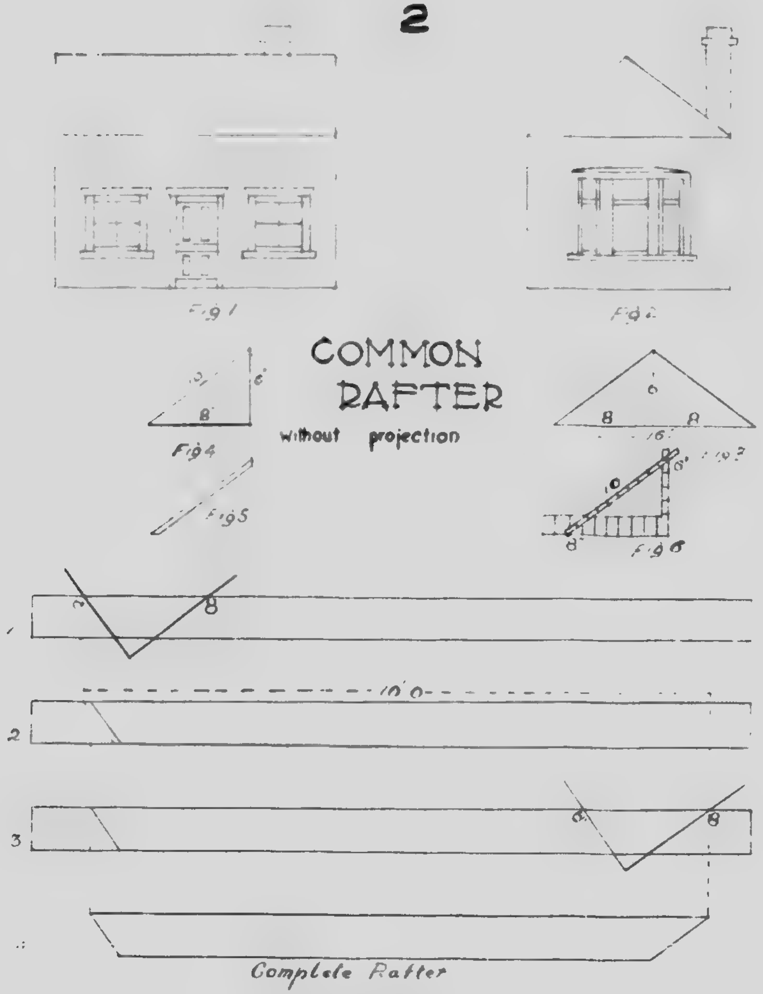
(17.) Taking for the plumb cut the angle at the top corner of the triangle, the method of marking it will be seen in (Fig. 1), of the work movements where the square is applied with 8″ and 6″ and the mark is made along the 6″ side.

(18.) The next move then is to measure the length 10″ from the point where the 6 was, down to the other point, which is now marked on the scantling.

(19.) Up to this point the work is the same for both the rafter with projection and the rafter without projection. In the one without projection one more move finishes it as seen in (Fig. 3, Plate 2), where the square is applied again with 8″ and 6″ to mark the seat line. But in the case of the rafter with projection, Plate 4, the square is reversed upside down with again 8″ and 6″ to mark the plumb line for the face of the wall, (Fig. 3), of the work movements. On this plumb line a point must be marked for the depth of the sizing, which is generally about half the thickness of the rafter, at the discretion of the framer. At this point mark the seat line by placing the square as shown in (Fig 5, Plate 4), with the 8″ and 6″ and mark on the 8″ side.

(20.) We have now marked what is called the bird's mouth, and but one angle mark more is required, which is the plumb cut for the extreme lower end of the rafter. To obtain this, place the square as in (Fig. 6), in conjunction with the seat line, sliding it out until the projection number is at that point, which will be at the edge of the plate. The pencil can then be drawn down the outside of the tongue to mark the projection as in (Fig. 7).

2



Layout of common rafter

PROBLEM I.

Part 1.

Description of the progressive steps of the system. Including the problem of the common rafter without projection.

(1.) In problems in roof work there are three stages, which will be called.

1st. The Statement.
2nd. The Essentials.
3rd. The Formula.

(2.) Explanation of the terms applied to these three stages.

1st. The statement is that stage in which the measurements of the roof are given, thus.

Statement.

(1). Span, 16′
(2). Rise, 6′

2nd. The essentials include that information of data which it is necessary to obtain from the statement and which it is essential to have in order to lay out the rafter in question.

3rd. The formula tells the successive movements that are gone through in laying out the rafter.

(3.) In this lesson the work of laying out a plain gable roof is undertaken, the rafters being all of one pattern.

(4.) This roof having no projection (Figs. 1 and 2), the rafters are of the most simple patterns (See Fig. 5).

(5.) The points which it is essential to know in order to lay out the pattern rafter for this roof are simply these:

Essentials.

(1). The run.
(2). The rise.
(3). The amount to allow for the ridge (if any).
(4). The length of the rafter.

COMMON RAFTER.

Explanation.

(1) These essentials are obtained in the following manner:

1st. The run is half the span, or it can always be looked upon as that distance covered by the rafter.

(2) 2nd The rise is the amount that the point of the rafter is higher than the heel.

(3) 3rd Assuming that the ridge is 1" thick, one half that amount requires to be allowed for, as shown in (Fig. 2) of the work movements.

(4) The length of the rafter is obtained by measuring across the square from run to rise as shown in (Fig. 6).

(5) The following will show the three stages as they exist, without any explanation or other instruction, but contains all the information necessary for framing a roof when the system is understood, and is given as an example of the way in which all the cases will be treated.

Statement of the Problem Given.

1st. Span 16′
2nd. Rise 6′

Complete List of Essentials.

1st Run 8′
2nd Rise 6′
3rd Amount to allow for ridge ½"
4th Length of rafter 10′

Formula.

(1). Mark the plumb cut.
(2). Measure down the length, allowing for half the ridge.
(3). Mark the seat line.

No. 2.

COMMON RAFTER.

Required, the length of the common rafter.

Run.	Rise.	Length.
6′	3′ 6″	6′ 11 11-32″
6′	4′	7′ 2 17-32″
6′	4′ 6″	7′ 6″
6′	5′	7′ 9 23-32″
4′	2′ 6″	4′ 8 19-32″
4′	3′	5′
4′	3′ 6″	5′ 3 25-32″
8′	4′	8′ 11 11-32″
8′	4′ 6″	9′ 2 5-32″
8′	5′	9′ 5 7-32″

Answers.

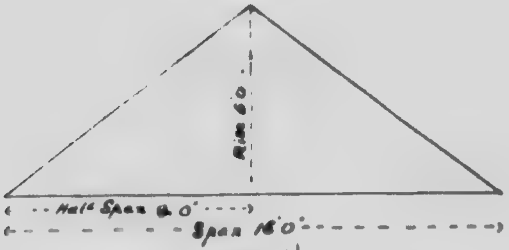


Fig 1.

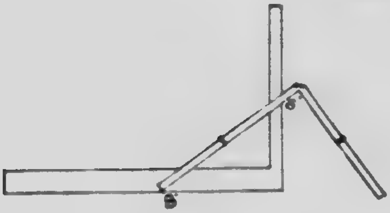


Fig 3.

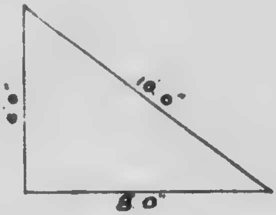


Fig 2

3

COMMON RAFTER
with projection

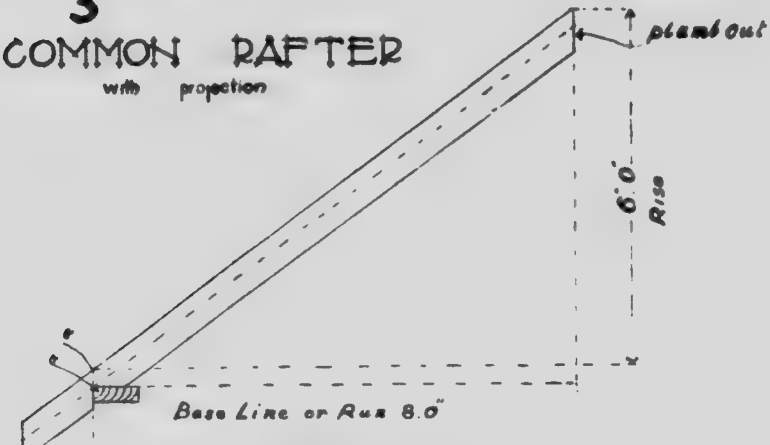


Fig 4.

PROBLEM I.

Part 2.

COMMON RAFTER WITH PROJECTION.

Statement.

(1). Span 16′
(2). Rise 6′
(3). Projection 10″

Complete List of Essentials.

(1). Run, 8′.
(2). Rise, 6′.

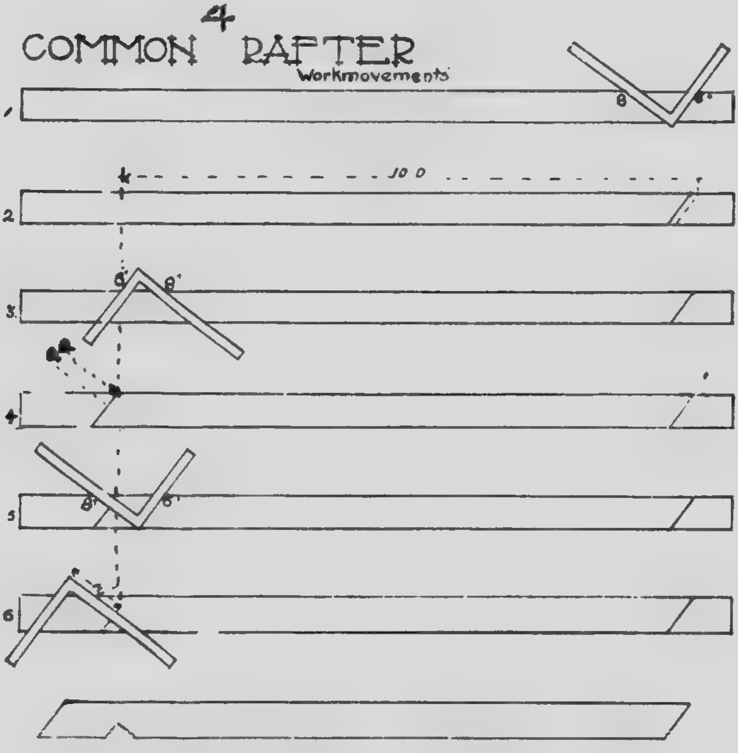
(3). Amount to allow for ridge, ½".
(4). Length of rafter, 10'.
(5). Depth of sizing, 2½".
(6). Projection, 10".

Explanation.

(1) The length is obtained by measuring from run to rise, see (Fig. 3).
(2) The projection is laid off as shown in (Fig. 6) of the work movements.

Formula for the Common Rafter.

(1). Mark the point cut.
(2). Measure down the length, allowing for half the thickness of the ridge.
(3). Mark the plumb line for the face of the wall.
(4). Mark the sizing.
(5). Mark the seat cut.
(6). Mark the projection.



Layout of rafter showing each proceeding

No. 3.

COMMON RAFTERS.

Required, the length of the common rafter and the lengths to be used for the plumb and seat cuts.

Span.	Rise.	Common Rafter.	Plumb Cut.	Seat Cut.
16′	6′	10′	6′	8′
16′	7′	10′ 7 9-16″	7′	8′
16′	8′	11′ 3 3-4″	8′	8′
13′	6′	8′ 10 1-8″	6′	6′ 6″
20′	9′	13′ 5 7-16″	9′	10′
17′	7′	11′ 1-8″	7′	8′ 6″
23′	11′	15′ 10 7-8″	11′	11′ 6″
26′	12′	17′ 8 3-8″	12′	13′
19′	6′ 6″	11′ 6 1-8″	6′ 6″	9′ 6″
7′	3′ 2″	4′ 8 5-8″	3′ 2″	3′ 6″
32′	12′ 8″	20′ 4 7-8″	12′ 8″	16′
40′	14′ 6″	24′ 8 1-2″	14′ 6″	20′

Answers.

Section 2

EVEN PITCHED HIP RAFTER.

LECTURE.

(1.) In approaching the problem of the hip rafter it will be well to notice that we have entered upon a different sphere of work, and that the case has different sides from which it may be viewed.

(2.) All the work of the common rafter is included in it and a great deal more added to it besides.

(3.) All the work of the common rafter is done in one plane, but in the hip problem there are three planes.

(4). The plane alluded to for the common rafter is vertical, and the face of the gable may be looked upon as that plane, with the rafter laid out upon it. The three different planes of the hip are as follows:

(First) The horizontal plane at the level of the plate of the building.
(Second) The vertical plane in line with the hip rafter which corresponds with the plane of the common rafter.
(Third) The plane in line with the back of the hip.

(5.) The work in the third plane can be evaded, and perhaps at this stage of the work it is better to leave it out and obtain the side cut by the simple method described in Figs. 4, 5 and 6 of the work movements.

(6.) This leaves but two planes in which we have to work, and let us consider the work of the horizontal plane first.

(7.) In the common rafter, it will be remembered that all we required was the rise and run, or perpendicular and base lines, and we could find the angles required for the cuts and the length of the rafter. Even so, in the hip we must have the rise and run to obtain the plumb and seat cuts, and length.

(8.) Now we already have the rise when we get out instructions stating the rise and span of the roof.

(9.) So it remains to us to find the run of the hip by the measurements of the plan of the roof, or better than that, by measuring the square from half span to half span. See Fig. 3, Plate 6, or Fig. 5, Plate 5.

(10.) Seeing that we are considering even pitched work, the hip, or more correctly its base line, is always at an angle of forty-five degrees to the plate and it is at the same angle to the end of the plate that it is to the side plate.

(11.) Many framers go by the rule that the diagonal of twelve and twelve is seventeen, so that the run of the hip would be seventeen inches for each foot run of the common rafter.

(12.) This method works very well when the run is in even feet, but when the run has odd inches in it, it becomes complicated.

(13.) Therefore for a universal rule we recommend the method of measuring the square from half span to half span.

(14.) Having now obtained the length of the run of the hip, we have the two necessary measurements, the rise and run, with which we can proceed to the second plane which will include the line of the base, (or run), the line of the rise and the hip itself.

(15.) As in the common rafter we measured from run to rise for the length, so we do for the length of the hip. (Fig. 4, Plate 6).

(16.) We have now gone as far as we can with the square and the rule alone, and the following proceedings must be with the wood itself.

(17.) As seen in (Fig. 1) of the work movements, the first thing to be done is to mark the plumb cut at the point of the rafter by applying the square with the rise and run of the rafter. This side of the rafter will be considered the face.

(18.) Mark a line square across the top of the rafter from this point and mark the plumb line on the other side.

(19.) Then for the splay cut mark another plumb line parallel with this line at a distance equal to the thickness of the stuff as shown at E. (Fig. 4). This line shows the length of the splay, that is, the rafter is sawn from this line to line number one.

(20.) By this method a cut is obtained which horizontally is at an angle of 45 degrees, and will fit the ridge as at F. to G. in the plan, (Fig. 2, Plate 6).

(21.) Having laid out the top end of the hip, the next thing to be done is to measure down the length.

(22.) This is done on the face side beginning at the point marked 6″ A. where we began to lay out the rafter.

(23.) From this point measure down the length of the hip as shown in Fig. 6, marking the length as shown at the point marked 6′.

(24.) Again apply the square with the rise and run. This time upside down, so as to mark a plumb line which will be in line with the face of the wall.

(25.) Now as this line is at the point where the hip passes over the edge of the plate, as at B., in plan (Fig. 2, Plate 6), it must be the same distance from the top of the hip rafter down t the plate as in the common rafter.

(26.) To understand what this means, compare the distance A. (Fig. 1, Plate 6, Common Rafter), with the distance B. (Fig. 1, Plate 6, Hip Rafter), and realise that they must be made to agree.

(27.) Therefore, first find out the height of A. on the common rafter and apply it to the hip as at a.a., (Fig. 8) of the work movements.

(28.) Apply the square with the rise and run as shown in Fig. 9 , to mark the seat cut.

(29.) Usually the bird's mouth at the heel of the hip is cut out square and the corner of the plate cut off on the line A.B., (Fig. 2, Plate 6), so that the lines a. a., (Figs. 8 and 9) work movements, are brought into the right position at B. (Fig. 2, Plate 6).

(30.) Though it may take some thinking, it is all important to realise that the face of the hip is exactly the same length as the center line of the hip, and that everything is in its right place just the same as if we worked on the center line.

(31.) When a ridge board is used, allowance must be made for half the thickness of the ridge to be deducted from each hip, as also from the common rafter.

(32.) To mark the projection a similar method is used to that of finding the base line of the hip.

(33.) For a twelve inch projection, 16 97-100″ can be used.

(34.) For a 10 inch projection, measure from 10 to 10 for the length of the projection of the hip. Whatever the projection, take the diagonal in the same way, applying the square to the seat line and sliding it out till the right figure is at the plumb line.

(35.) But it will be found in practice that it answers well to leave the bottom of the hip till after it is raised and then cut it off in line with the other rafters.

5. HIP RAFTER

For Even pitched roof

Introductory

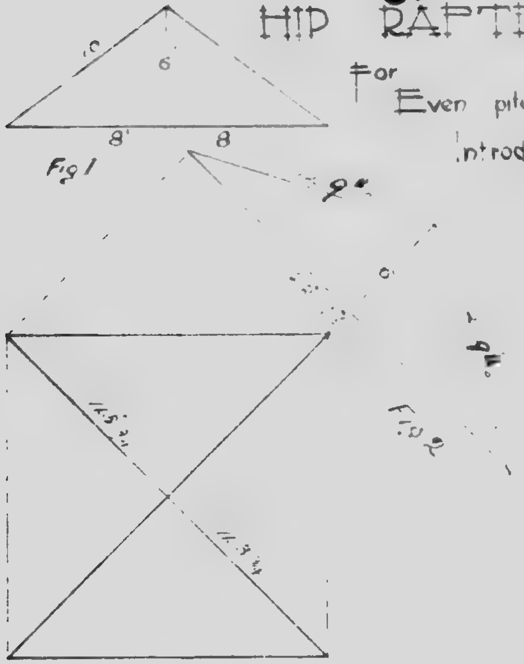


Fig 1

Fig 2

Fig 3.

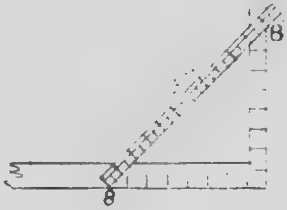


Fig 5.

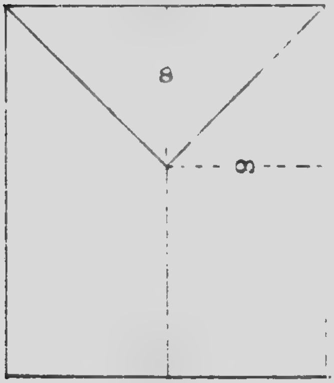


Fig 4.

INTRODUCTION TO PROBLEM II.

(1.) This lesson is preparatory to the even pitched hip rafter problem.

(2.) The purpose for which this paper is intended is to divide the problem of the even pitched hip rafter into two parts.

(3.) The first part is entirely devoted to finding the run of the hip rafter.

(4.) The second part covers the entire work of laying out the hip rafter.

(5.) In order to lay out the hip rafter it will be necesary to know the run and the rise.

(6.) As seen by comparing Fig. 1 and Fig. 2, both common and hip rafters have the same rise.

(7.) The run of the common rafter is half the span, which as seen in Fig. 1 will be 8″ in this case.

(8.) The run of the hip is half the span from corner to corner as seen in Figs. 2 and 3 .

(9.) To obtain the length of this span measure the square from 16″ to 16″ which will give 22′ 7½″.

(10.) But as we only require half of this for the run of the hip, we will measure from 8″ to 8″ which will give 11′ 3¾″ for the run of the hip.

(11.) The exercise sheet given with this paper, required the measurement which is obtained by measuring from half span to half span, as shown in Fig. 5.

(12.) It will be seen by comparing Figs. 3 and 4, that the run of the hip is the same no matter whether the building is square, or if the hips meet a ridge as in Fig. 4.

No. 4.

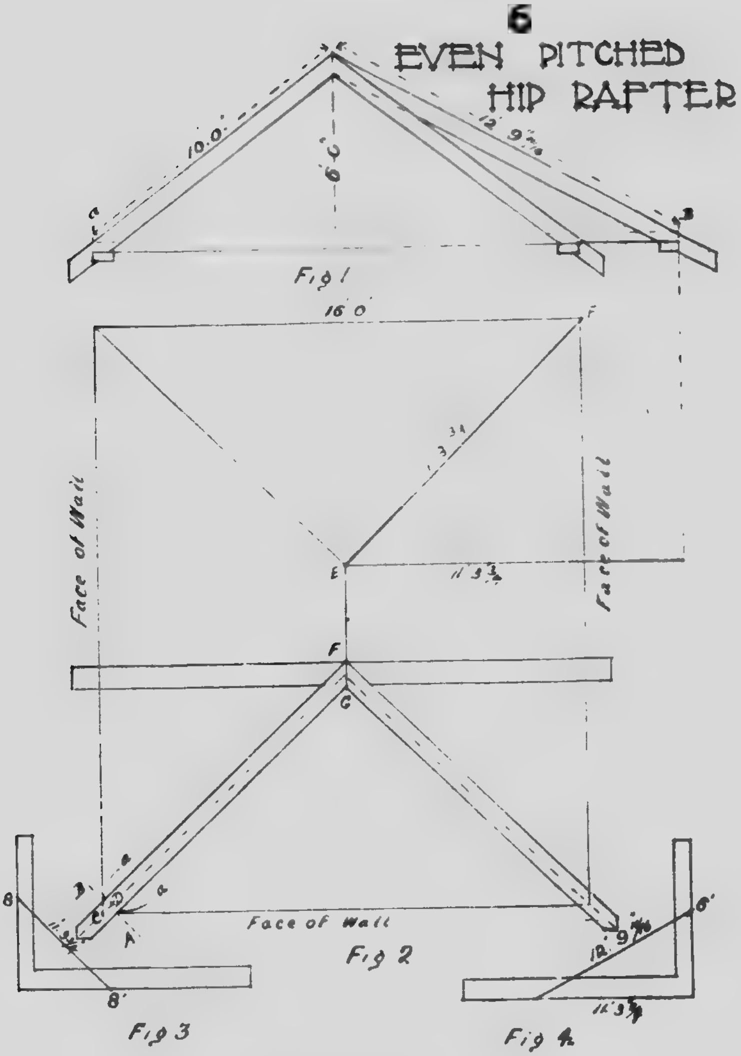
HIP RAFTERS.

Even Pitched Roof.

Required, the length of the run of the hip rafter.

Half Span.	Run.
8′	11′ 3 3-4″
9′	12′ 8 3-4″
13′	18′ 4 5-8″
12′	16′ 11 5-8″
9′ 3″	13′ 1″

Answers.



PROBLEM II.

EVEN PITCHED HIP RAFTERS.

(1.) Taking the even pitched roof in the three different stages and treating them in order, the points to be considered will be as follows:

(2.) There are only three actual measurements necessary for the framing of an even pitched hip roof and these are the same as for the common rafter.

The Statement.

1st. Span.
2nd. Rise.
3rd. Projection.

Explanation.

One point is understood, that is, that we are dealing with an even pitched roof and therefore the run of the hip is always at an angle of 45 degrees to the plate.

The Essentials.

Before laying out the hip there are a number of points which we must know and which strongly resemble those of the common rafter.

In ordinary cases they will be these:—

(1). Run of hip.
(2). Rise.
(3). Amount to allow for ridge.
(4). Amount to recede for splay cut.
(5). Length of hip.
(6). Perpendicular depth of sizing.

Explanation.

(1) To obtain the run of the hip it is of the greatest importance to understand just the position which it occupies.

(2) With this in view, observe the plan drawing, Fig. 2, which shows the run of the hip from E. to F.

(3) This can easily be imagined as a horizontal line lying from the corner of the building to a point directly under the end of the ridge.

(4) Now observe that the line has travelled across a square which is equal to half the span of the building in both dimensions.

(5) Therefore to find the length of the run, measure from half span to half span, as shown in Fig. 3.

(6) The rise is the same as for the common rafter.

(7) The amount to allow for the ridge is easily laid off when laying out the rafter.

(8) The amount to recede for the splay cut is equal to the thickness of the rafter.

(9) The length of the hip is obtained by measuring from run to rise, see Fig. 4.

(10) The perpendicular depth of the sizing is shown at B. Fig. 1. This measurement is ascertained from the common rafter and applied to the hip as shown in Fig. 8 of the work movements.

(11) The projection of the hip is as well left to be cut in line with the other projecting rafters after they are raised.

(12) (Note) Another way to obtain the splay cut of the hip is to apply the square to the back of the hip with the length and run, the length side will be the angle for the splay. A similar method is used for the splay cuts of jack rafters.

The Formula for Laying Out the Hip.

(1.) Mark the point cut.

(2.) From that point mark square across the top.

(3.) Mark the plumb line on the other side.

(4.) Recede the thickness of the rafter and mark another plumb line.

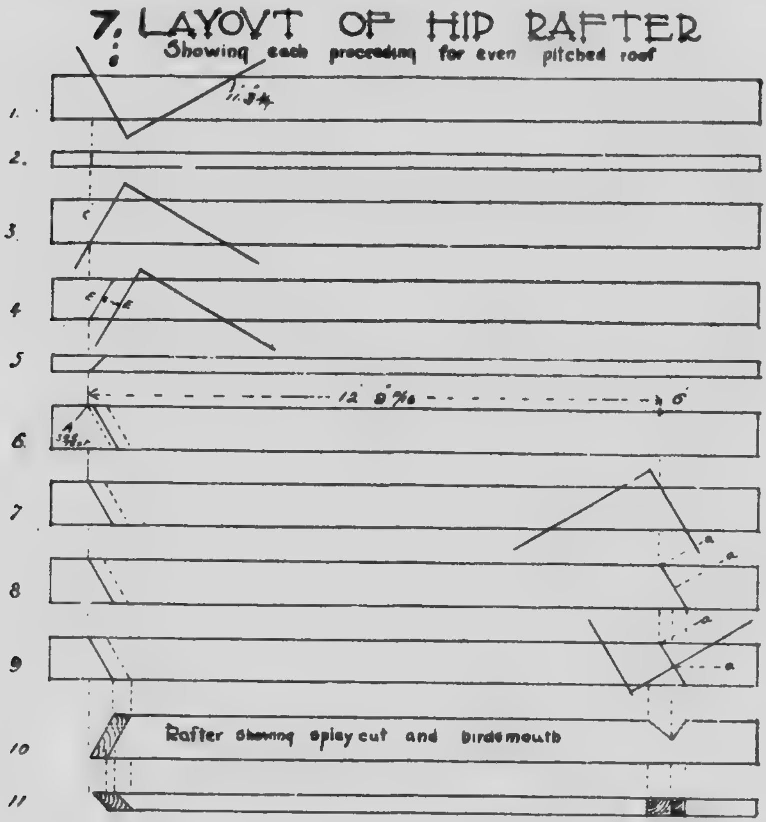
(5.) Join the first plumb line and the last on the top showing the angle.

(6.) Measure down the length on the face side.

(7.) Mark the plumb line for the face of the wall.

(8.) Measure down the perpendicular depth of the sizing.

(9.) Mark the seat line.



7. LAYOUT OF HIP RAFTER

Showing each proceeding for even pitched roof

No. 5.

HIP RAFTERS.

Even Pitched Roof.

Required, the run and the length of the hip rafter, and the amount to recede square from the plumb line for the splay (which on even pitched work will be 2" when the material is two inches"), and the length to be used for marking the splay on the top of the rafter.

Lengths to be used for splay.

Span.	Rise.	Run of Hip.	Length of Hip.	Amount to recede.
16'	6'	11' 3 3-4"	12' 9 11-16"	2"
16'	7'	11' 3 3-4"	13' 3 5-8"	2"
16'	8'	11' 3 3-4"	13' 10 1-4"	2"
13'	6'	9' 2 1-4"	10' 11 5-8"	2"
20'	9'	14' 1 3-4"	16' 9 1-8"	2"
17'	7'	12' 1-4"	13' 11"	2"
23'	11'	16' 3 1-8"	19' 7 5-8"	2"
19'	6' 6"	13' 5 1-4"	14' 11 1-16"	2"
7'	3' 2"	4' 11 3-8"	5' 10 1-2"	2"
32'	12' 8"	22' 7 1-2"	25' 11 1-8"	2"
40'	14' 6"	28' 3 3-8"	31' 9 3-8"	2"

Answers.

Section 3

JACK RAFTERS FOR EVEN PITCHED ROOFS.

LECTURE.

(1.) The problem of jacks in an even pitched hip roof is comparatively simple, when the common rafter and the hip are understood.

(2.) The best way to look upon the problem is to see each space to be filled in with jacks as a triangle. And to illustrate this, let us look upon a roof in the condition ready to have the jacks placed in it. See spaces 2, 3 and 4, Fig. 2, Plate 8.

(3.) According to general custom the rafters are raised first, then the hip rafters, leaving the spaces for the jacks till the last.

(4.) Now take for example the roof represented in Fig. 2, there are four spaces to be filled in with jacks, numbered 1, 2, 3 and 4. All of these are equal and may be looked upon as in pairs. Requiring that the splay cut shall be on opposite sides for each pair, as for instance the jacks for section 3 would not fit in section 4 though the same lengths would prevail in both cases. And seeing that the same lengths will work in on opposite sides of the hip we make these jacks in pairs with the splay cuts on the opposite sides.

(5.) Each of these sections is a right angled triangle and it is most important to realise the position of this triangle, as this is the key to the whole situation.

Take the case of section 4, Fig. 2 which is a standard case. This triangle is bounded on its three sides by:—

1st. The first full lengthed rafter.
2nd A piece of plate from that rafter to the corner of the building which will be equal in length to half the span.
3rd. The hip which is the hypothenuse of the triangle.

(6.) In all cases this triangle is the first thing to be looked for and no one need expect to lay out jacks satisfactorily without knowing the dimensions of this triangle, which dimensions are the lengths of the two sides adjoining the right angle.

(7.) These two sides are always spoken of as the length and run of the common rafter, which statement though true, is apt to be misleading, (for the student is apt to think of this as the angle which is formed by the junction of the rafter and its base line at the plate, which of course is the seat cut).

(8.) But instead of looking upon this line as lying horizontally under the rafter, take it as lying at right angles to the rafter and extending along the plate to the corner of the building.

(9.) Therefore observe that the right angle is formed by the rafter and the line extending along the plate.

(10.) And now understanding the line along the plate and the rafter line adjoining it, which are the sides of the triangle, join their extreme points and this line will be found to be the length of the hip.

(11.) When you look at the position of this triangle it will be seen that it can not be shown correctly either in a plan or in an elevation, looking at it from the side or end.

(12.) To prove this, look at section 2, plate 8, which is in the plan drawing as looked upon from above. All that can be shown is a triangle with sides 8 and 8. This is not the triangle we want to find.

(13.) Again look at Fig. 1 which is an end elevation. This shows a triangle of 6 and 8 which does not give us yet what we want.

Therefore it is evident that the triangle for the jacks can not be shown either in plan or elevation.

(14.) Seeing that this jack triangle is neither level or plumb, but is in an inclined plane of its own, and the only way to show it in a drawing is to view it as if looking at it at right angles as from the point C, Fig. 1.

(15.) Looking at any section of a roof from a point at right angles to it we get what is known as the stretchout view, and that is where we see its actual size and the shape of that section of the roof.

(16.) The term stretchout really means that we take a view of the roof of the building as if stretched out flat upon the ground and make a drawing as if we were looking straight down upon it.

(17.) Having then the measurements of the roof, it is easy to draw the stretchout for the jacks as shown in Fig. 2, Plate 8.

(18.) In this case the length of the common rafter is 10′ A. to B. and the line A. C. is equal to the run of the common rafter.

(19.) In drawing therefore, it just remains to space out and draw in the jacks, and their actual lengths are obtained and also the splay cut.

(20.) But this triangle has further uses, though in fact the drawing can be dispensed with when the square is understood.

(21.) True, the upper angle of this triangle in the drawing is the splay cut of the jacks.

(22.) But we obtain the splay cut with the square by applying it with the length of the common rafter and its run as in Fig. 4 and mark on the side which contains the length of the rafter.

(23.) So the entire summary of the steel square system of obtaining the splay cut is, apply the steel square to the scantling with the length and run of the common rafter and mark on the length.

(24.) The plumb and seat cuts are of course the same as for the common rafter.

(25.) There still remains the most simple method of obtaining the splay cut which is the same as for the hip. Recede the thickness of the rafter as shown in Fig. 3. This means that the dotted line is at a distance from the point line the distance C., Fig. 3, which is equal to the thickness of the rafter.

(26.) In laying out the jacks there are but two important points to be considered, the splay cuts and the length.

(27.) And the splay having ben treated, it just remains to consider the problem of lengths, or the amount that each jack is diminished from the one above it.

(28.) Many good framers constantly use the drawing system.

(29.) Others who are less expert find the lengths by measuring the positions of the jacks on the building.

(30.) A method of obtaining this length by the steel square is worked thus:

Mark the plumb line as for a common rafter, and taking 16″ spacing for example, slide the square down, keeping it by the plumb line until the 16″ mark on the blade strikes the top of the rafter. Fi
5, Plate 8.

(31.) Now the 16″ mark is at the point of the next jack rafter. It answers well to take a common rafter and mark all the lengths of the jacks upon it by repeating the application of the steel square as in Fig. 5. The effect of which will be seen in Figs. 6 and 7.

(32.) The principal object in Fig. 7 is to show how the lengths of the jacks work out upon the common rafter.

(33.) It usually works out well to splay the first full lengthed rafter, and place the center of it on the plate at the distance of half the span from the corner of the building.

(34.) This will be the same distance from the corner as the center rafter at the end of the building. Therefore the same lengths will answer for jacks on both sides of the hip.

(35.) One matter of detail must not be overlooked which is of importance to understand. In the common rafter, it is understood that allowance is made for the ridge. Also in the hip we must do the same because the theoretical lines which we get for the lengths of the common rafters and hips, count from the edge of the plate to the center of the ridge.

(36.) Even so with jacks, the theoretical length runs to the center of the hip or valley. So if the jacks were cut the theoretical lengths they would all turn out to be too long. Therefore for a two inch hip they require to be horizontally about 1½″ shorter than the theoretical length.

(37.) Now in reviewing the description that has been given, it will be found that this has been allowed for.

(38.) In the first place the common rafter is shortened ½″ to allow for the ridge. Then when we take it at this length and splay, back the thickness of the rafter horizontally, it really shortens the jack an inch. Therefore by simply following the system we obtain the desired effect without any calculating.

(39.) At this juncture, after so thoroughly going into the matter of obtaining the splay cut of jacks by applying the length and run of the common rafter, it is well to mention that the splay cut of the hip is obtained by applying the length and run of the hip and marking on the length.

(40.) But for the explanation of that problem we will have to wait till we come to the lecture on irregular or unequal pitched roofs.

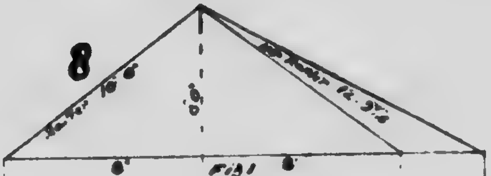


Fig 1

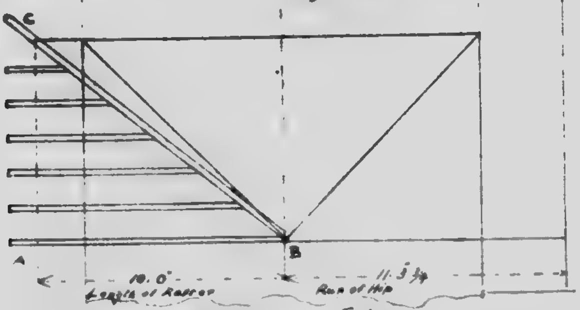


Fig 2

JACK RAFTER

For even pitched roof

Method 1

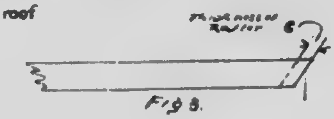


Fig 3.

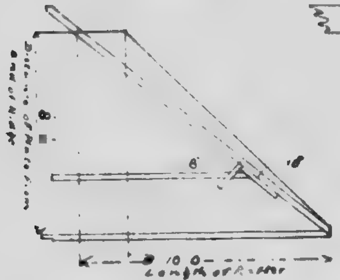


Fig 4

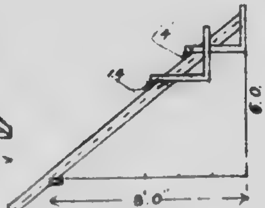


Fig 5.

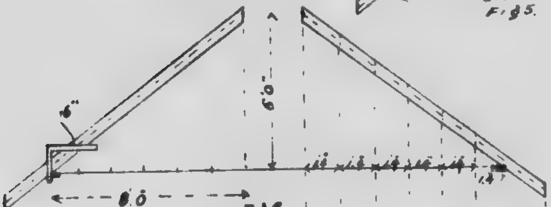


Fig 6

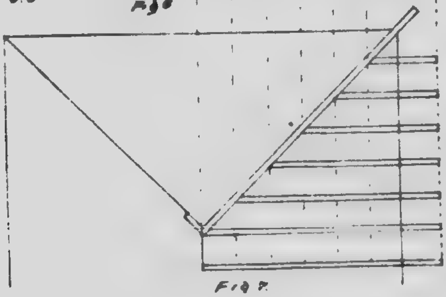


Fig 7.

.9.
WORK MOVEMENTS of Jack Rafters

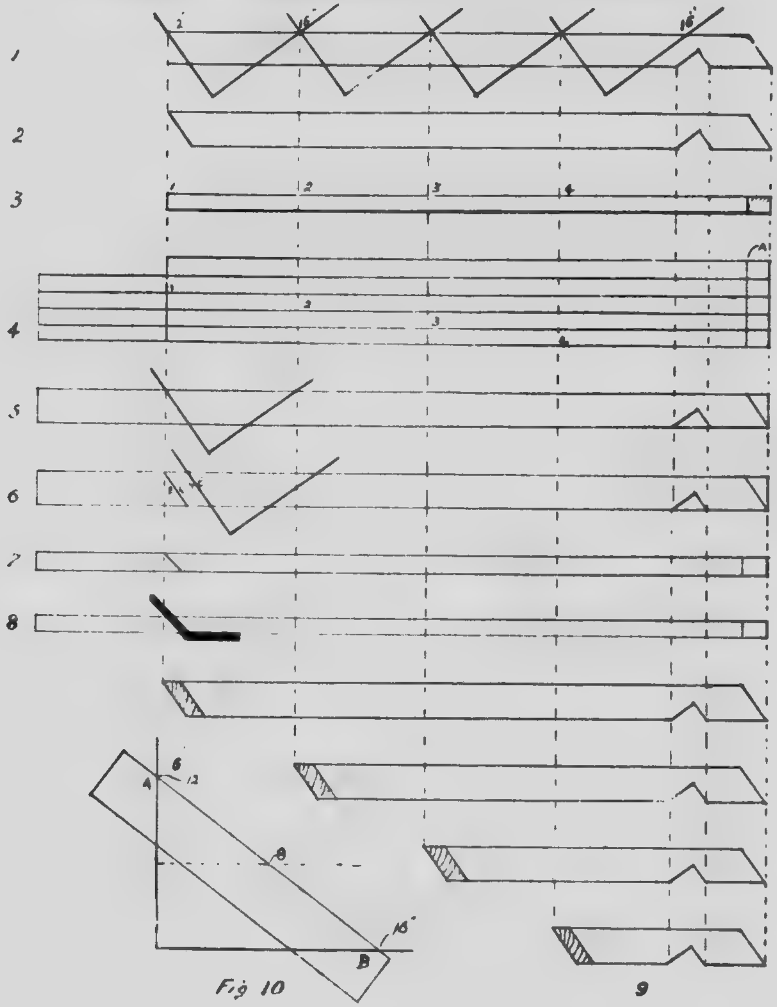


Fig 10

9

PROBLEM III.

JACK RAFTERS FOR EVEN PITCHED HIP ROOFS. Method 1.

Note. In many cases the teacher will find it advisable to omit method 1, as it is limited to even pitched work, and it does not answer to teach two methods.

It will be understood that in this case we are still treating a roof of the same span and rise as in the previous examples.

Therefore the statement of the dimensions and conditions is the same, omitting the ridge which has already been allowed for in laying out the common rafter.

The points necessary for laying out a set of jacks are these:—

Statement.

(1) The layout of the common rafter.
(2) The rise per 16″, (or the rise per space of rafters).
(3) The amount to recede for the splay.

essentials to be obtained before laying out the jacks are these:—

(1) The rise per space of rafters.
(3) The amount to recede for the splay cut.
(3) The layout of the common rafter.

Explanation.

(1) The rise per 16″ or per space is obtained by applying the square to a board with the rise and run as shown in Fig. 10, Plate 9, and then sliding it down till the 16″ mark on the blade strikes the edge of the board. The tongue will then show the amount to rise, which is in this case 12″.

(2) The amount to recede for the splay cut in even pitched work is always the thickness of the rafter.

(3) The layout of the common rafter is obtained from the rise and run of the roof.

(4) (Note) The first jack being the same length as the common rafter, its centre is 8′ from the corner of the building, the same as the centre end jack.

FORMULA FOR LAYING OUT THE HIP JACKS.

(1.) Apply the square to the scantling as shown in Fig. 1, with 12″ and 16″ (for the space and rise per space), and repeat this, marking the plumb cut each time, as often as it is contained in the common rafter.

Fig. 2 shows the scantling with the length of the jacks marked on it.

(2.) Mark all these lengths square across the top of the rafter as shown in Fig. 3.

(3.) Lay the necessary number of scantlings on the trestles and carry these lengths across, also the line A., Fig. 4, to show where to place the pattern to mark the heel.

(4.) From the plumb cut, recede the thickness of the scantling E to E., Fig. 6.

(5.) Mark the splay by joining the two lines at the top. Fig.7.

(Note) It will save time to set a bevel to the splay cut, to mark the other jacks by.

Figure 9 shows the jacks complete in their relation to the length marked on the common rafter.

No. 6.

JACK RAFTER.

These examples apply to the foregoing hip roofs, Nos. 2 and 3.

Required, the rise per 16″ in the following examples, and the amount to recede square from the plumb line for the splay cut in 2″ scantling.

Span.	Rise.	Rise per 16″.	Amount to recede.
16′	6′	12″	2″
16′	7′	14″	2″
16′	8′	16″	2″
13′	6′	14 3-4″	2″
20′	9′	14 3-8″	2″
17′	7′	13 3-16″	2″
23′	11′	15 5-16″	2″
19′	6′ 6″	10 15-16″	2″
26′	12′	14 3-4″	2″
7′	3′ 2″	14 1-2″	2″
32′	12′ 8″	12 11-16″	2″
40′	14′ 6″	11 5-8″	2″

Answers.

10

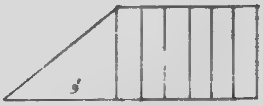


Fig 1

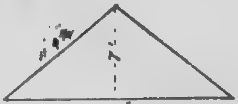


Fig 2

JACK RAFTERS method 2

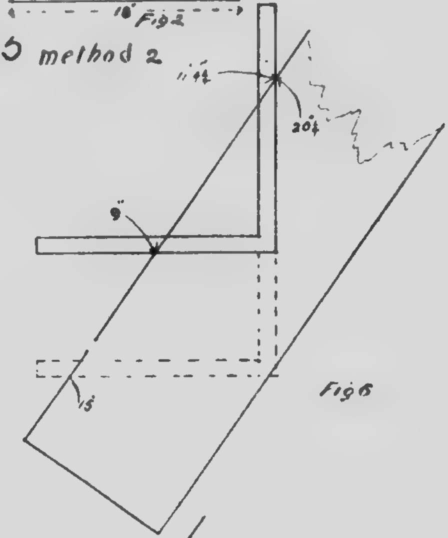


Fig 6

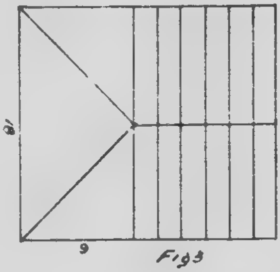


Fig 3

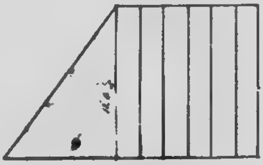


Fig 4

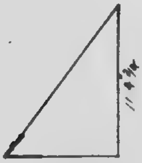


Fig 5

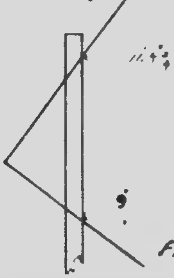


Fig 7

LECTURE.

JACK RAFTERS. Method 2.

(1.) This method of finding the lengths of jack rafters can be applied to all cases.

(2.) It is understood that there is a three cornered space to be filled in with jacks, and that one corner is square.

(3.) The length of the two sides adjoining the square corner are known as in Fig. 5, will be seen 9'x11' 4¾".

(4.) Now observe where we find this triangle.

Figs. 1 and 2 are the side elevations of the roof.

Fig. 3 is the roof as if looking down upon it from above, the spaces for the jacks being vacant.

(5.) Fig. 4 is one side of the roof as if laid out flat on the ground, showing the actual shape and size of the triangle.

Therefore when the common rafters and hips are raised we find a triangle left of the dimensions of 9′x11′ 4¾

(6.) Taking the work in three stages as follows, it will be found that all that we need in the statement will be the length of the two sides of the triangle, and a common rafter upon which to work.

(7.) For the essentials, all that we require will be the length of the common rafter, the distance from the common rafter to the corner of the building, and the amount that each jack rafter differs in length from the one next to it, which amount we will call the diminishing length. See Fig. 6.

(8.) To obtain this length, place the square on a board as shown in Fig. 6, with the lengths of the two sides of the triangle, then slide to the amount of the spacing, in this case we have 16″.

The other side of the square will then show the length required.

(9.) All plumb and seat cuts will be the same as for the common rafter.

(10.) The length is always taken from the extreme point of the jacks.

(11.) Proper allowance must be made for half the thickness of hips and valleys.

Statement.

(1) Length of common rafter, 11′ 4¾″.
(2) Distance from the common rafter to the corner of the building, 9′.
(3) We require a common rafter laid out to work upon.

Essentials.

(1) Length of common rafter, 11′ 4 ¾″.
(2) Distance from common rafter to the corner of the building, 9′.
(3) Diminishing length, 20¼″.

Formula.

(1) Mark all the successive lengths of jacks on the common rafter.

(2) Carry the lengths over on to the jacks.

(3) Mark the splay as shown in Fig. 7, by applying the square with the two sides of the triangle, and mark on the side which contains the length of the rafter.

These examples apply to the foregoing hip roofs, Nos. 2 and 3.

No. 7

Required, the amount that each jack is shorter than the one above it, which amount will be called the diminishing length, and the lengths to be used for the splay cuts.

			Splay Cuts	
		Diminishing	Common Rafter	
Span	Rise	Length	Run	Length
16′	6′	20″	8′	10′
16′	7′	21 1/4″	8′	10′ 7 9/16″
16′	8′	22 5/8″	8′	11′ 3 3/4″
13′	6′	21 3/4″	6′ 6″	8′ 10 1/8″
20′	9′	21 1/2″	10′	13′ 5 7/16″
17′	7′	20 3/4″	8′ 6″	11′ 1/8″
23′	11′	22 1/8″	11′ 6″	15′ 10 7/8″
26′	12′	21 3/4″	13′	17′ 8 3/8″
19′	6′ 6″	19 3/8″	9′ 6″	11′ 6 1/8″
7′	3′ 2″	21 5/8″	3′ 6″	4′ 8 5/8″
32′	12′ 8″	20 5/12″	16′	20′ 4 7/8″
40′	14′ 6″	19 3/4″	20′	24′ 8 1/2″

Answers.

Section 4.

EVEN PITCHED VALLEY RAFTERS.

Lecture.

(1.) As with the common rafter and the hip the first thing to be done is to find the length.

(2.) In an L-shaped roof of even pitch having the same span in both wings and the same rise there will be one hip and one valley required.

(3.) Therefore the same method of finding the length of the run is correct; which is to measure from half span to half span, Fig. 9, Plate 12, in this case 8 to 8.

(4.) The same rule always prevails that the length of the run must be found, the rise being simply the height of the roof the same as for the common rafter.

(5.) Therefore find the length of the valley by measuring across as in the other cases from run to the rise.

(6.) As in all other cases this triangle contains the angles for the plumb and seat cuts.

(7.) This L-shaped roof is taken as an example to show that in this position in a roof without projection, the hip and valley are just like a pair of common rafters.

(8.) All that is required in the statement is the span and rise, and the condition of being an L-shaped roof. The essentials are:—

Run.
Rise.
Length.

(9.) The only difference between the hip and valley is that the valley is shortened horizontally at the top, half its thickness.

(10.) They may butt together at the top and the ridges can be attached to the sides, being cut on the splay.

(11.) In Plate 11 the rise of the roof is 6′ and the run of the valley is 11′ 3¾″, so the square is applied with 6′ and 11′ 3¾″ as it was for the hip in Plate 7.

(12.) The base line of the valley, A. B., Fig. 1, is at an angle of 45 degrees to the ridge line. Therefore the splay cut against the ridge must be at an angle of 45 degrees.

(13.) To obtain this cut:—
Mark the point of the valley all round as for a common rafter, Figs. 1, 2 and 3, work movements; and recede the thickness of the rafter. E. to E., Fig. 4.

This is in 2″ stuff, at a distance of 2″ from the plumb line draw another plumb line as per drawing and this will give the length of the splay. See Fig. 8, Plate 12. Allowance must, of course, be made for half the thickness of the ridge.

(14.) There is a notable peculiarity about the position of the valley with regard to its depth where it passes over the plate, which differs from both the common and hip rafters. For the purpose of gaining some information and to draw a comparison which may assist in making clear the relative positions of hip and valley rafters, it will be well to compare the detail of the heel of the hip with the detail of the heel of the valley.

(15.) It will be noticed that the hip was drawn in the amount of half its thickness at the corner of the building, so as to bring it to the right height to agree with the common rafter. This is done to avoid backing or bevelling off the corners of the hip to make the roof boards fit. By the method here described there is always a small vacancy along the back of the hip, which is left by reason of the roof boards merely touching the corners and not touching the centre of the hip.

(16.) Now seeing that a difficulty of the same kind arises with the valley it is necessary to consider what is going to be done. The usual way to treat this is to place the valley so that a straight edge applied to the face of the common rafters of the roof will strike the valley in the centre. That is, the surface of the rafters will be in line with the centre of the valley. Now by this it will be seen that the edge of the valley will be below the surface of the rafters. Therefore when the roof boards are cut on the mitre down the valley, merely the edge will be touching the centre of the valley rafter. Therefore that vacancy which the hip had along its centre, the valley has along its sides.

(17.) From the foregoing explanation it will be evident that the valley where it passes over the plate, is (in its centre) at the same height as the common rafters, and the sides are lower. For this reason it is indispensable that the valley be laid out so that the centre is at the height of the common rafter and not the side as with the hip.

(18.) Seeing that the centre of the valley where it passes over the plate is the same height as the common rafter it must continue in the same plane all the way up, and this has a peculiar effect in the case of long and short valleys where one roof intersects with another as in Plate 11. Following the centre of the valley from where it passes over the plate and keeping in the plane of the common rafters when we arrive at the main ridge we are still in the centre of the valley, at the edge of the ridge. The effect is that one side of the valley is lower than the ridge and the other side is projecting above it, which will have to be cut off down to the level of the common rafter, from the ridge of the smaller roof upwards.

(19.) Having so far studied the position of the valley, it will be evident that the plane of the jacks will have to be in accordance with the face of the common rafters and the centre of the valley. For this purpose the top ends of jacks are nailed to the ridge the same as the common rafters, and the bottom end is raised so as to support the roof boards in line from the common rafter to the centre of the valley, which brings the face of the jack somewhat higher than the edge of the valley to which it is nailed.

(20.) Now after these various deliberations regarding the position of the valley, let us proceed to lay it out.

(21.) The top splay has already been treated, and the next step is to measure the length, which may be done in several different ways, all bringing about the same result.

(22.) In measuring the hip, the long side was found to be the correct theoretical length (the same as the centre), therefore we measured on that side.

(23.) The length G. to B., Fig. 13, Plate 12 is the same as the long side of the hip would be for the same span and rise. Therefore we begin to measure on that side, making allowance for the ridge as from G. to F., Fig. 3, beginning at the point G. and proceeding the length of the valley, which terminates at B., Fig. 3, at which point we mark a plumb line, as also on the opposite side at C., Fig. 3. This measurement is shown from B. to A., Fig. 8, work movements.

(24.) Again receding half the thickness of the valley from B. to A., Fig. 3, mark another plumb line as also at D., Fig. 3, and Fig. 8 of the work movements.

(25.) Now to get the correct position for the seat line, measure down the plumb line A., Fig. 3, the same height as the line on the common rafter at the edge of the plate. See A., Fig. 3, Plate 12. It will then be evident that the point E. in plan, Fig. 3 will be the same height as the common rafters at the edge of the plate.

(26.) The valley may then be cut on the lines B. E. and C. E., Fig. 3, and on the seat line.

(27.) It is seldom considered worth while to lay out and cut the projection of the valley until it is in position.

(28.) There are several ways to find the length of the long valley, but let two suffice for the present.

(29.) (First) Take the drawing method in Fig 1, Plate 11, which drawing includes the length of the long valley as erected on its base line A. B. From B., at right angles to A. B., erect the line B. C., the height of the rise of the roof, in this case 6′. A. C. is the length of the long valley; A. D. is the length of the short valley; and 4′ 6″ is the rise of the intersecting roof.

(30.) (Second) The steel square method.

(1) As the great run is to the great rise, so the lesser run is to the leser rise. See Fig. 5, Plate 12.

(2.) As the long valley is to the great rise, so the short valley is to the lesser rise. See Fig. 4.

(31.) To work these proportions by the square.

(1st) According to Fig. 5, applying the square to a board 8 and 6, draw a line along the 8 side.

Keeping the square by this line, slide it back to the 6, which is the lesser run. The lesser rise will be indicated on the tongue to be 4′ 6″.

(32.) (2nd) Applying the square with 6 and 12′ 9 11-16″, the great rise and the length of the long valley, draw a line along the 12′ 9 11-16″. Keeping by this line, slide the square back to 4′ 6″ on the tongue. The blade will be at the length of the short valley. See Fig. 4, Plate 12.

(33.) By proportion: (Arithmetically).

8′:6′ = 6′:4′ 6″.

12′ 9 11-16″:6 = 9′ 7 1-2″.4′ 6″.

(34.) The same plumb and seat cuts are used for the short valley as for the long.

(34.) The point cut of the short valley is square like a common rafter.

(35.) It will be correct to measure down the outside of the short valley, (that is, the side to which the main roof jacks are nailed) to the point at the edge of the plate which corresponds to B., Fig. 3, Plate 12, and then lay out the heel in the same manner as the long valley.

(37.) In the case of forgetting on which side to measure the length of these valleys, always place yourself as standing betwen the valleys, and it will be the side away from you. The same rule holds good for all kinds of pairs of hips and valleys.

(38.) After following the system of laying out jacks for the hip roof, there is not much to be said about the valley jacks.

(39.) The method of obtaining their successive lengths is the same, but the detailed shape at the ends is different, and the allowances to be made for the ridge and the valley are taken in a different way. The top of the jack is the same as on the common rafter. Be sure to make the correct allowance for half the valley and half the ridge.

(40.) In laying out the hip jacks this detail t care of itself in this way:—

(41.) Half an inch was taken off for the rid

(42.) The rafter was splayed back from the mon rafter length, thereby shortening it an horizontally in the centre.

(43.) In all making it 1 ½" shorter horizontally than the theoretical length.

(44.) Now with the valley we are still making the common rafter the basis upon which to lay off the jacks.

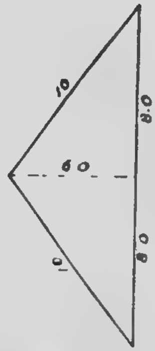
(45.) There is still the ½ inch taken off at the ridge.

(46.) It is perhaps hard to realize, but that ½ inch does not count with the valleys as it did with the hip. It is taken off the valley as well as the common rafter at the ridge and there still remains the amount to take off at the bottom of the jack to allow for half the thickness of the valley.

(47.) The amount will be 1 ½" horizontally as shown from F. to G., Fig. 3, which will bring the extreme lower end ½" short of the edge of the plate at H., Fig. 3, Plate [illegible].

(48.) So the rule can be followed to shorten ½ an inch from the line for the face of the wall on the common rafter for the length of the longest jack in the pattern.

.11.



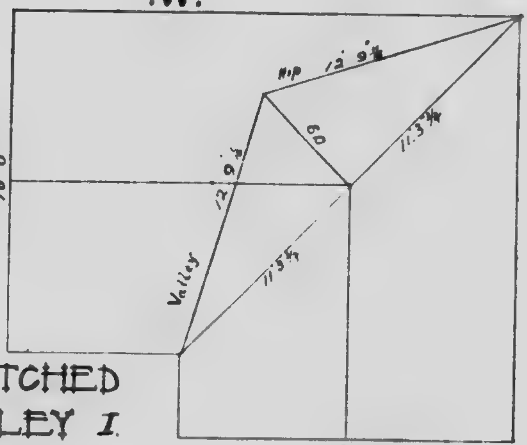


Fig 6.

EVEN PITCHED VALLEY I.

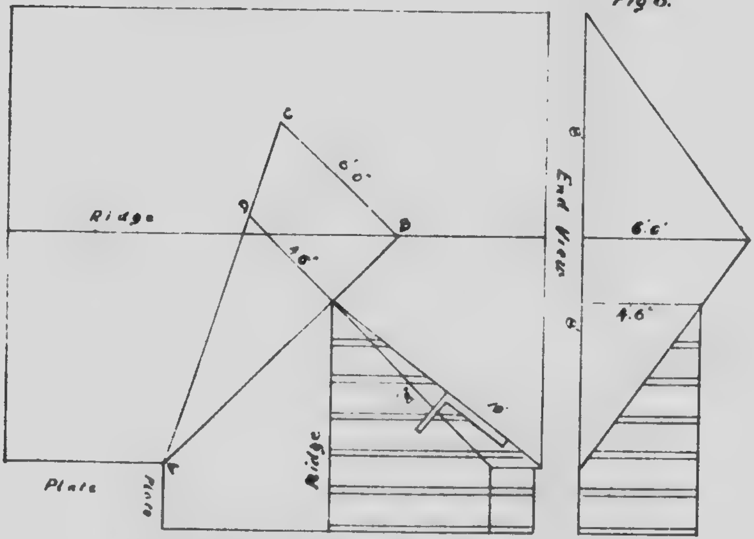


Fig I.

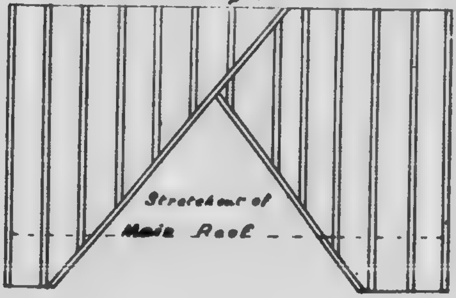
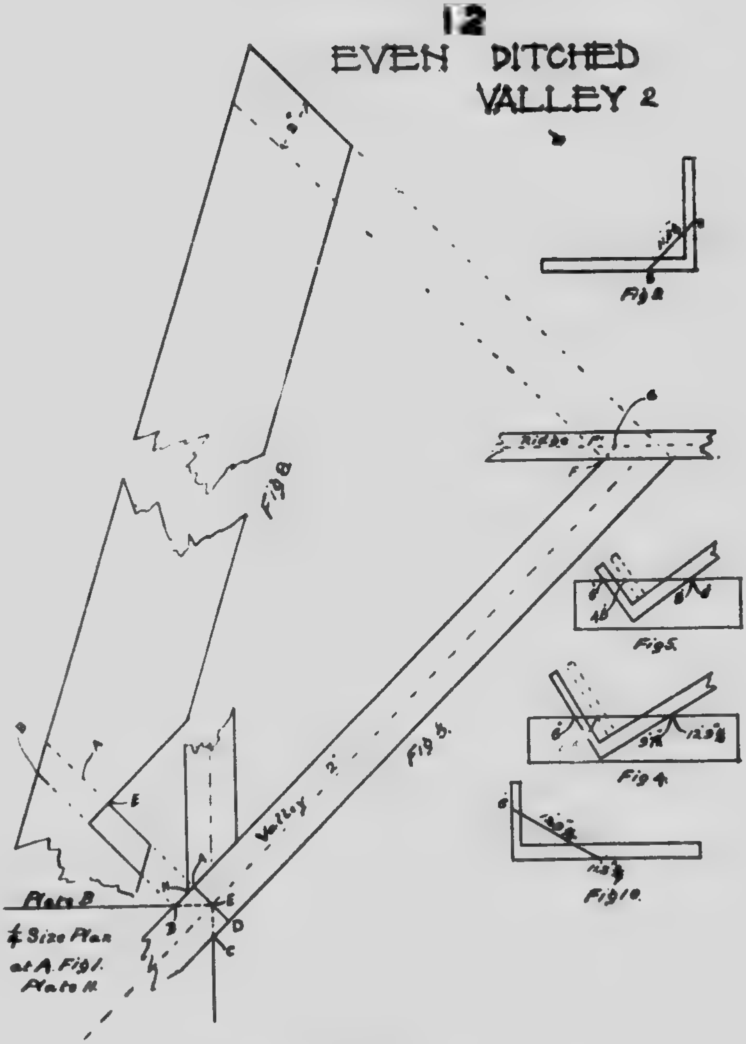


Fig 2.



PROBLEM IV.

EVEN PITCHED VALLEYS.

The points which require to be stated in order to proceed to lay out a valley rafter in an even pitched roof are much the same as for the hip

But when there is a smaller roof entering the main roof being of the same pitch, one more point requires to be known from which all the additional information is gathered.

This being, the span of the small building shown in the statement.

Statement.

(1) Main Span, 16′.
(2) Rise, 6′
(3) Thickness of Ridge.
(4) Perpendicular depth of sizing.
(5) Lesser Span, 12′.

The essential points which we must know in order to lay out the rafter can be obtained from the statement by working the rules which follow this list.

Essentials.

(1) Run.
(2) Rise.
(3) Amount to allow for ridge.
(4) Amount to recede for splay cut.
(5) Length of long valley.
(6) Perpendicular depth of sizing.
(7) Length of short valley.

Explanation.

(1) The method of finding the run of the long valley is the same as for the hip. Measure from half span to half span, or in this case 8′ to 8′. Fig. 9, Plate 12.

(2) The allowance for the ridge can be made with least trouble in laying out the rafter.

(3) The amount to recede for the splay is equal to the thickness of the rafter.

(4) The length of the long valley is obtained from the run and rise. Fig. 10, Plate 12.

(5) The length of the short valley is obtained by two different motions of the square, as in Figs. 5 and 6, Plate 12. First by placing the square on a board as shown in Fig. 5, with the main run and rise 6′ and 8′, then sliding to the lesser run 6′, the tongue will show the lesser rise to be 4′ 6″.

(6) Then with the square, as in Fig. 6, with the length of the long valley 12′ 9 11-16″, and great rise 6′, slide back to 4′ 6″ and the blade will show 9′ 7 1/4″ for the length of the short valley.

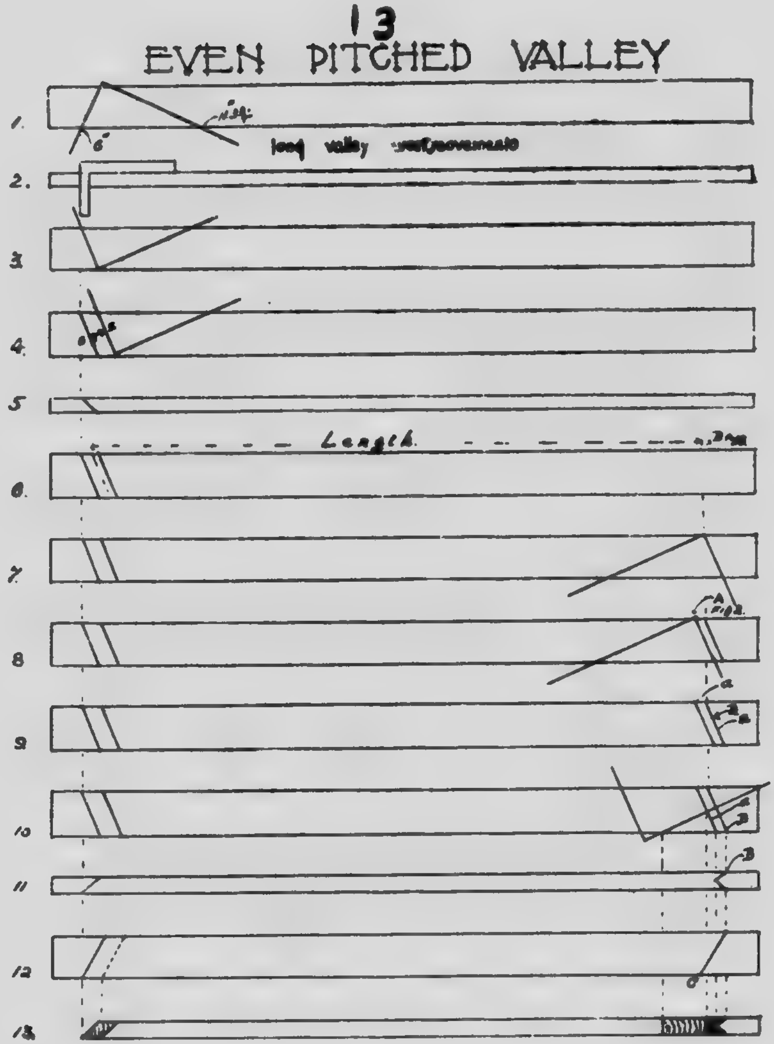
Formula for Laying Out the Long Valley.

(The case shown is for a long valley on the left hand side). See Figs. 1 and 2, Plate 11.

(1) Mark the point cut.
(2) Mark square across the top.
(3) Mark the plumb line on the other side.
(4) Recede the thickness of the rafter for the splay.
(5) Mark the splay on the top and allow for the ridge.
(6) Measure down the length.
(7) Mark the plumb line for the face of the wall. See B., Fig. 3, Plate 12.
(8) Recede half the thickness of the scantling and mark the plumb line in the position marked A., Fig. 3, Plate 12.
(9) Measure down the depth of the sizing on the line A.
(10) Mark the seat line.
(11) Lines A. and B. can be marked across the bottom and the frog marked as shown.
(12) The line C. can be marked on the other side to guide in sawing. Observe the position of Fig. 3.

Explanation.

(1) The bottom of the rafter when cut will appear as in Fig 13.
(2) For the formula of the short valley all that is necessary is the finding of the length, which is done as before stated.
(3) Then for the work; the formula consists of marking the point cut with the same plumb and seat line as for the long valley.
(4) This cut is square across like a common rafter.
(5) From it measure down and form the heel the same as the other valley. One peculiarity that this rafter possesses, is that both sides are alike so that it will fit either right or left hand.
(Note) The length and run of the valley can be used for the splay cuts the same as for the hip. Always mark on the length.



No. 8.

VALLEYS.

Even Pitched Roofs.

Required, the lesser rise is to be obtained by proportion. As the lesser span is to the main span, so the lesser rise is to the main rise.

$$12 : 16 = x : 6$$

Main Span.	Main Rise.	Lesser Span.	Lesser Rise.
16′	6′	12′	4′ 6″
16′	7′	11′	4′ 9 3-4
16′	8′	9′	4′ 6″
13′	6′	8′	3′ 8 1-4″
20′	9′	11′	4′ 11 7-16″
17′	7′	6′	2′ 5 5-8″
23′	11′	20′	9′ 6 3-4″
19′	6′ 6″	14′	4′ 9 1-2″
7′	3′ 2″	4′	1′ 9 3-4″
32′	12′ 8″	24′	9′ 6″
40′	14′ 6″	30′	10′ 10 1-2″

Answers.

No. 9.

VALLEYS.

Even Pitched Roofs.

Required, the length and run of the long valley; the length of the short valley; the lengths to be used for the splay cuts; and the amount to recede square from the plumb line for the splay.

Lengths to be used for splay cuts.

Main Span.	Main Rise.	Run.	Length of Long Valley.
16′	6′	11′ 3 3-4″	12′ 9 11-16″
16′	7′	11′ 3 3-4″	13′ 3 5-8″
16″	8′	11′ 3 3-4″	13′ 10 1-4″
13″	6′	9′ 2 1-4″	10′ 11 5-8″
20″	9′	14′ 1 3-4″	16′ 9 1-8″
17″	7′	12′ 0 1-4″	13′ 11″
23′	11′	16′ 3 1-8″	19′ 7 5-8″
19′	6′ 6″	13′ 5 1-4″	14′ 11 1-16″
7′	3′ 2″	4′ 11 3-8″	5′ 10 1-2″
32′	12′ 8″	22′ 7 1-2″	25′ 11 1-8″
40′	14′ 6″	28′ 3 3-8″	31′ 9 3-8″

Answers

Lesser Span.	Lesser Rise.	Short Valley.	Amount to recede for splay.
12′	4′ 6″	9′ 7 1-2″	2″
11′	4′ 9 3-4″	9′ 1 3-4″	2″
9′	4 6″	7′ 9 1-2″	2″
8′	3′ 8 5-16″	6′ 9 1-16″	2″
11′	4′ 11 7-16″	9′ 2 5-8″	2″
6′	2′ 5 5-8″	4′ 10 7-8″	2″
20′	9′ 6 7-8″	17′ 0 7-8″	2″
14′	4′ 9 3-8″	10′ 11 7-8″	2″
4′	1′ 9 3-4″	3′ 4 1-8″	2″
24′	9′ 6″	19′ 5 3-8″	2″
30′	10′ 10 1-2″	23′ 10 1-8″	2″

Answers.

Section 5.

PEDIMENT AND VALLEY JACKS.

LECTURE.

(1.) It quite frequently happens that a pediment is to be built on the face of a roof without the span or rise of the main roof being given; the span and rise of the pediment only being stated.

So in this case we will proceed as if we did not know anything about the measurements of the main roof.

(2.) In Fig. 1 we have a front view of the main roof, showing in dotted lines the rafters and header enclosing the opening to be covered with the pediment.

(3.) Consider the span as 8 feet and the rise as 6 feet.

(4.) Lay out a rafter for this rise of 6 feet and run 4 feet, with the bottom end to be sawn off, as if to fit a plate, and at the point making an allowance for the ridge.

(5.) Now for the splay; the measurement we require is the distance to rise on the inside from B. to C., Fig. 5.

(6.) To obtain this amount, set a scantling up as shown in Fig. 3, marking from A. to B.

(7.) This scantling can be sawn on that line for one of the front studs. Fig. 4.

(8.) Next, the rafter splay is obtained by rising as shown in Fig. 5, from B. to C.

(9.) We can now cut the first pair of rafters and set them up in position.

(10.) It is a simple matter to put in the ridge when the first pair of rafters is raised and in position.

(11.) There is always an important point to be realized in each problem in roof work. That point now, is to recognize that we have a triangle in the side of this pediment, the elevation of which is seen in Fig. 2. The right angle being formed by the front rafter and the ridge.

(12.) This triangle is shown by the stretchout, A.B.C., and the dimensions are seven feet, two and a half inches, and eight feet.

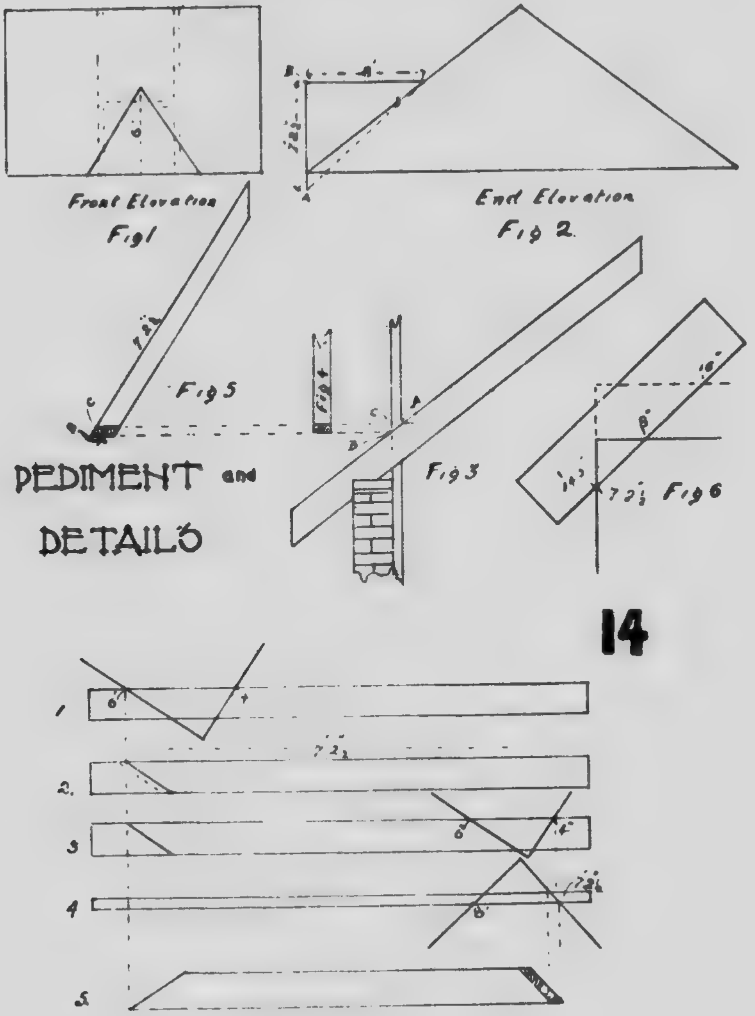
(13.) To cut the angle for the roof boards, apply the square to the board with these figures as in Fig. 6, marking on the eight inch side.

(14.) For the splay of the foot of the jacks use the same figures but mark on the side of the seven feet, two and a half inches.

(15.) To find the length for the next pair of jacks apply the square, as shown in Fig. 6, with the length of the ridge and the length of the front rafter, then slide to the 16 and the other side will give the length to diminish.

(16.) This rule can be worked to find the length of jacks in any case where the two sides of the triangle are known, also the splay cut for the jacks and the cut for the roof boards.

(17.) The splay cut for the jacks is just the same in either case; it makes no difference whether they set on the face of the roof or if they nail on the side of the valley, the only difference being that to set on the roof the cut is horizontal, while with the jacks which nail on the side of the valley the cut is plumb.



PEDIMENT and DETAILS

PROBLEM V.

Pediments.

To construct a pediment, the statement which is generally given only includes the span and rise.

But to make this first exercise more simple we will in this case give the length of the ridge as well.

Statement.

(1) Span.
(2) Rise.
(3) Length of ridge.

Essentials.

(1) Run.
(2) Rise.
(3) Length of front rafter.
(4) Length of ridge.

Formula.

(1) Mark the plumb cut.
(2) Measure down the length, allowing for half the ridge.
(3) Mark the seat cut.
(4) Mark the splay cut.

Explanation.

The splay can be obtained by using the length of the front rafter and the length of the ridge, see Fig. 4 in the layout positions.

No. 10.

Pediments.

Required, the length of front rafter, diminishing length of jacks, the amount to recede on the inside for the splay, and the lengths to be used for the splay cuts.

Span of Pediment.	Rise of Pediment.	Length of Ridge.	Length of Front rafter.
8′	6′	8′	7′ 2 9-16″
10′	5′	5′	7′ 7-8″
7′	4′	6′	5′ 3 3-4″
12′	4′	8′	7′ 2 9-16″
11′	5′	6′	7′ 5 3-16″
14′	9′	10′	11′ 4 7-8″

Answers

Diminishing length of Jack rafters.	Amount to recede square up from the seat line for the splay cut.
14 7-16″	1 1-2″
22 5-8″	2″
14 1-8″	1 5-16″
14 7-16″	1″
19 5-6″	1 11-16″
18 1-4″	1 13-16″

Answers.

Section 6.

IRREGULAR VALLEYS.

Lecture.

(1.) There is a regular set of requirements which are essential in every problem in roof work, of which the three main points are:—

Length,
Plumb cut, and
Seat cut.

(2.) These three we must have, for all rafters contain them, and the man who thoroughly masters their use and application is not at all likely to have trouble over the other points, which are:—

Side or splay cut, and
Projection.

Which last term relates to the overhang of the roof beyond the wall, and involves the correct sizing of the rafter where it passes over the plate and the plumb cut at the lower end of the rafter.

(3.) Granted that the plumb and seat cuts and length are the prime necessities, let us first look at them and see where to begin, and what steps to take to obtain the length, and place the proper lines upon the scantling.

(4.) As before, the first thing to be done is to find the length of the run, which may be done in different ways as we shall see.

(5.) For the even pitched roof, it was simply:— Take half the span on the blade and half the span on the tongue and measure across.

(6.) This was when the span was 16′ to measure from 8″ to 8″ which is nearly 11′ 3¾″.

(7.) Now that is just the same as measuring a board 8″x8″, from corner to corner.

(8.) Even so, if the board was not square, for instance if it was 4″x8″, we could measure across just as easily.

(9.) And if we wanted to know that length without having the board to measure, we would just measure the square from 4 to 8.

(10.) So, when the base line or run is not at an angle of 45 degrees, we must know what the two measurements are which we are to use to find the run.

(11.) So the first thing to be done is to find these measurements.

(12.) The span of the main roof is 16′ and its rise 5′; and the span of the pediment is 5′ 6″ and its rise 4′.

(13.) These are all the measurements that are given and they are all that are necessary to frame this roof. There still remains one cut which is so hard to get with the square that in practice it is better to take it from the drawing, viz., the splay cut at the point of the short valley. The splay and length of the main roof jacks are treated here by drawing to be taken up later with the square alone.

(14.) There is a line made use of in finding the run of the valley which it will be well to designate the cross run which abbreviated would be C.R.

(15.) To understand this term, look at Fig. 3, Plate 15, where the cross run of the short valley is from A. to B.

(16.) The run of the common rafter is from G. to L., Fig 3. If the cross run was only one foot the increase in length would be trifling, but with each additional foot of cross run, the valley lengthens faster.

(17). With the even pitched roof this swing or cross run was equal to the run of the common rafter. But in this example the cross run or swing is much less.

(18.) Therefore to find the run of the long valley all we require is the run of the roof and the cross run of the valley.

(19.) This example with the long and short valleys is purposely given to show that the cross run of the long valley is not stated or given in any way in the four measurements given. But we have a key to it, and by putting the figures we have through the right formula we can get it, and for this it is not necessary to find the length of the ridge of the pediment.

(20.) As finding the length of the long valley is a long operation, it will be well to make a summary of the different operations which are gone through to get it, beginning at the last and going back to the first, each time studying the position to see why each move is necessary.

(21.) 1st. Find the length of the long valley by proportion with the short one. Fig. 4, Plate 17.

2nd. Find the lengths of the short valley from its rise and run. Fig. 3, Plate 17.

3rd. Find the run of the short valley from half the span of the pediment and the length of the ridge. Fig. 2.

4th. Find the length of the ridge by proportion. Fig. 1, Plate 17.

(22.) Now we have to get back to the points stated, so this time we begin at the beginning and go through to the end.

(23.) To find the length of the ridge of the pediment, proceed thus:—

(24.) As the great rise is to half the span, so the lesser rise is to the length of the ridge. Fig. 1, Plate 17.

(25.) Apply the square with the great rise and half the span or run, draw a pencil line along the run side, and, keeping the square by this line, slide back to the lesser rise. The blade will be at the length of the ridge. See Fig 1, Plate 17 which is A.E. in Fig. 3, Plate 15.

(26.) To find the length of the run of the short valley, we have the length of the ridge, A.E., Fig. 3, Plate 15, and the C.R. of the short valley, which is half the span of the pediment, A.B., Fig. 3, Plate 15.

(27.) So with these measurements on the square we get the run of the short valley as E.H., Fig. 3, Plate 15.

(28.) Now that we have the run and rise of the short valley, the length of the short valley can be found in the usual way by measuring from run to rise.

(29.) Having found the length of the short valley, the rise and run give the plumb and the seat cuts for both valleys.

(30.) To find the length of the long valley, compare the length of the long valley in proportion with the great rise, as the short valley is to the lesser rise. See the 1st and 2nd positions of the square in Fig. 4, Plate 17.

(31.) So far we have just been dealing with the length of the valleys and the plumb and seat cuts, the next part of the work is to consider the side cuts.

(32.) The plumb and seat cuts will be easy to get as we have the rise and run of the short valley, which will answer for all the positions where plumb and level cuts are required.

(33.) So this leaves but one angle to be found with the square:— That is, the angle at the top end of the long valley, which same angle applies to the heel of both valleys. To find this angle with the square we have to resort to what has been called the plan method, or the method of receding.

(34.) This method is universally useful, and though it is the very simplest kind of development it appears that most men find it difficult to understand. So to insure this question being thoroughly understood and appreciated, it will be well to take it slowly and surely, step by step.

(35.) The process of scribing one piece of wood to fit another is so generally known that it does not need to be described here; but the principle employed here may be considered the same. Therefore the long valley may be looked upon as scribed to fit against the ridge, which would be quite easy if the plumb cut was cut square across like a common rafter and then laid up against the ridge, scribed around with the compasses and then cut to that line.

(36.) But instead of this we have a method which requires less exertion.

(37.) By scribing, all we found out was how much to take off, or how much to recede on the short side, and this depends on the angle at which we approach the ridge, and as the angle at which we pass over the plate is the same, we can better proceed to find the angle at the plate.

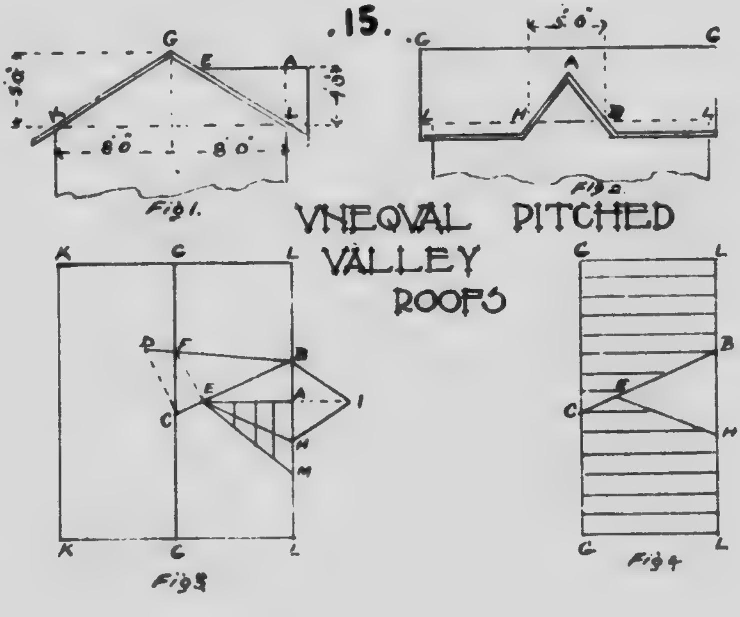
(38.) In Fig. 3, Plate 15, the triangle E.A.B. is formed by the length of the ridge and half the span of the pediment. With these two measurements apply the square as in Fig. 4½ and mark both splays. Plate 17.

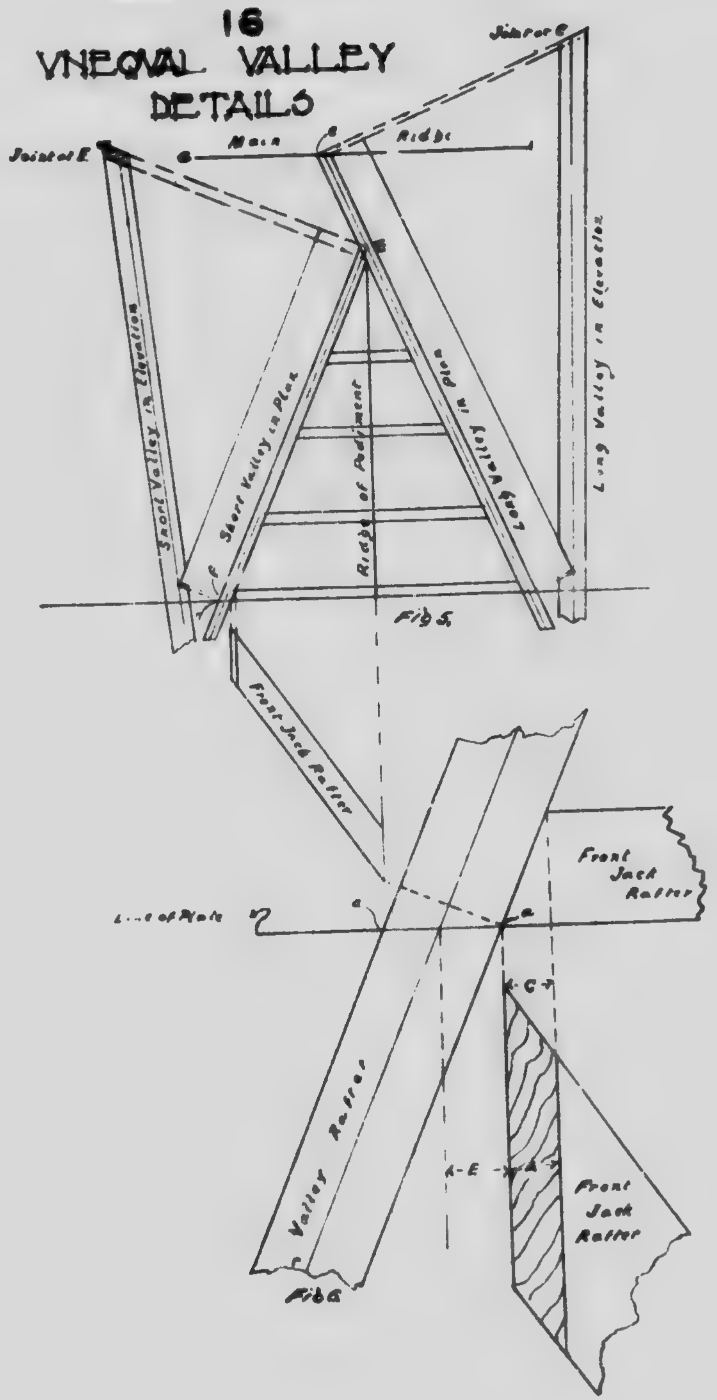
(39.) Draw a line square across from the end of the splay, to the point Fig. 4½. From R. to S. will be the amount to recede for the valley against the ridge and at the bird's mouth, as shown at the joint C. and heel a-f, Fig. 5, Plate 16.

(40.) The same amount is correct to recede for the splay of the pediment jacks, as will be seen in the detail showing the front jack rafter. Fig. 5 and at A., Fig. 6, Plate 16.

(41.) A convenient fact is, that the opposite splay is correct for the jacks of the main roof, a stretch-out of which is seen in Fig. 4, Plate 15.

(42.) Note. It is seldom that valleys are used in so small a roof, but the lesson loses nothing by its being small and it leaves the drawing small enough at 1" to the foot to go on an ordinary drawing board.




16
VNEQVAL VALLEY
DETAILS
Joint at E
Main
B
Ridge
Joint at B
Short Valley in Elevation
Short Valley in Plan
Ridge of Pediment
Long Valley in Plan
Long Valley in Elevation
E
Fig 5.
Front Jack Rafter
Front Jack Rafter
Line of Plate
e
a
C
E
A
Valley Rafter
Front Jack Rafter
Fig 6

17

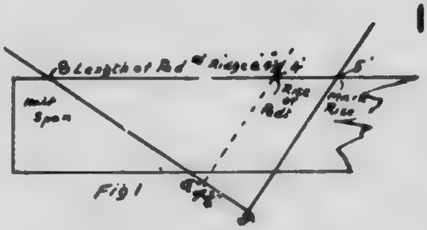


Fig 1

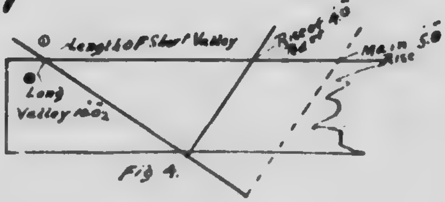


Fig 4.

VNEQVAL PITCHED VALLEY RAFTER ESSENTIALS

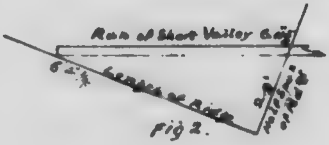


Fig 2.

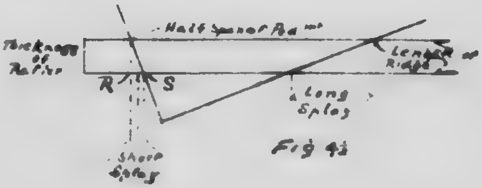


Fig 4½

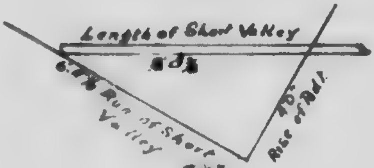
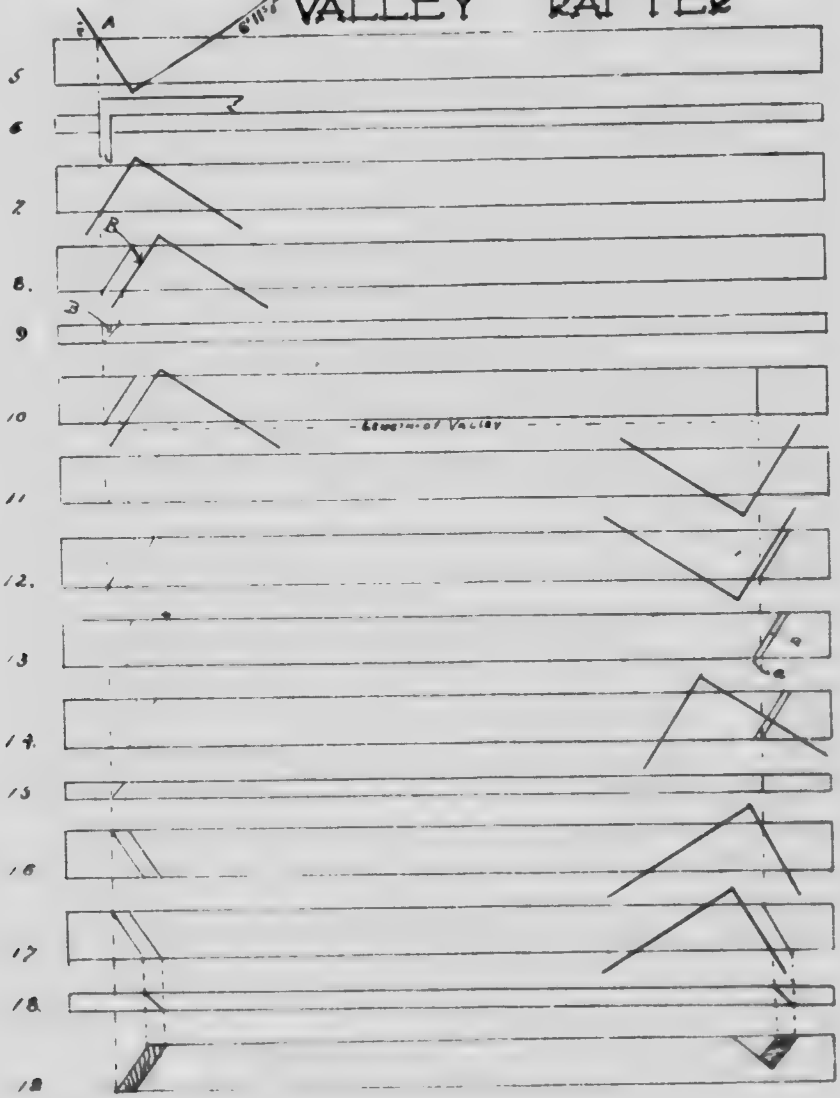


Fig 3.

18 WORKMOVEMENTS OF VNEQVAL VALLEY RAFTER



PROBLEM VI.

Unequal Pitched Valleys.

In this, as in all cases, there are the three stages, and in each one certain necessary points to be obtained, considered, and made use of.

Even so, this case of the unequal pitched valley has an increased number of points beyond those of the even pitched roof.

As the amount of the projection does not effect this problem, it will not be necessary to state it, but merely to consider the perpendicular depth of the sizing.

The points requiring to be stated will be as follows:—

Statement.

(1) The main span.
(2) The main rise.
(3) The lesser span.
(4) The lesser rise.
(5) Thickness of the ridge.
(6) Perpendicular depth of sizing.

Having the statement we may now proceed to find the essential points for laying out the valley rafters which are as follows:—

Essentials.

(1) Main rise.
(2) Main run.
(3) Lesser rise.
(4) Lesser run.
(5) Length of ridge intersecting building.
(6) Length of short valley.
(7) Length of the long valley.
(8) Amount to recede for splay cut.
(9) Perpendicular depth of sizing.

Explanation.

(1) The first move to be made is to find the length of the ridge of the intersecting building, or, its length from a point above the plate to where it dies into the main roof.

(2) To do this the square is applied to a board with the half of the main roof and its rise, Fig. 1, Plate 17. Then draw back to the rise of the intersecting roof and the blade will show the length of the ridge as required.

(3) Now imagine a line lying directly below the ridge of the pediment, and of the same length, horizontal, and at the level of the plate.

(4) From the inner end of this line to the foot of the valley is the run of the short valley.

(5) So to find this run, take on the blade the ridge length on the tongue half the pediment span as shown in Fig. 2, Plate 17.

(6) To find the length of the short valley measure from run to rise. Fig. 3, Plate 17.

(7) Now that we have the short valley it is a matter of proportion to find the length of the long valley.

(8) As shown in Fig. 4, Plate 17, apply the square to a board with the lesser rise and the length of the short valley.

(9) Slide the square till it comes to the main rise; the blade will show the length of the long valley.

(10) To find the amount to recede for the splay cut, apply the square with half the pediment span and the length of the ridge as in Fig. 4½. Square this across and recede the amount R.S. for the pediment jacks as well as both valleys.

(11) To find the splay cut for the top of the short valley by the square is so long a process that it is not worth while. At this stage, therefore, it will be better to draw a detail showing the joint as if looking down perpendicularly upon it.

(12) (Method 2.) To obtain the amount to recede, cut the end square across like a common rafter, and scribe it to its place; which will be correct and save hesitation.

(13) The perpendicular depth of the sizing will be obtained from the common rafter.

Formula for Laying Out Unequal Pitched Valleys.

(5) Mark the point cut, using run and rise of short valleys.

(6) From this mark square across the top.

(7) Mark the plumb line on the other side.

(8) Recede for the splay and mark the other plumb line for the splay B.

(9) Mark the splay on the top of the rafter at B.

(10) Measure down the length from the short side of the splay, allowing for ½ the ridge.

(11) Mark the plumb line for the face of the wall.

(12) Recede half the amount of the splay which was obtained in Fig. 4½ and mark a plumb line.

(13) And measure down this line the depth of the sizing (a) to (a).

(14) Mark the seat cut.

(15) Mark square across the top of the rafter from the line for the face of the wall which was applied in Fig. 11.

(16) From this mark a plumb line which will be opposite the first line on the other side.

(17) Recede full amount and mark the other plumb line for the splay cut.

(18) Mark the splay cut on the bottom of the rafter.

(19) This shows the rafter complete.

(Note) The length of the short valley is taken in this case, on the long side, as it is in all valleys, and the birdsmouth formed the same as the long valley.

The length being taken on the outside, no allowance need be made for the space occupied by half the thickness of the long valley.

(Note) In the case of the main roof having the steeper pitch, the inside of the short valley will be the longer, but the length is still correctly taken on the outside, and allowance has to be made for the inside being longer than the outside.

No. 11.

Irregular Valleys.

These examples apply to the intersection of roofs of different pitches.

Required, the length of the ridge of the intersecting building.

Main bldg.		Int'sect'g bldg.		Length of ridge of intersecting building
Span.	Rise.	Span.	Rise	
16′	5′	5′ 6″	4′	6′ 4 3-4″
30′	15′	12′	8′	8′
18′	12′	10′	6′	4′ 6″
18′	10′	18′	8′	7′ 2 3-8″
21′	9′	14′	6′ 6″	7′ 7″
40′	16′	21′	12′	15′
26′	12′	13′	7′	7′ 7″
38′	16′	17′	10′	11′ 10 1-2″
28′	13′	16′	9′	9′ 8 5-16″
				Answer.

No. 12.

Irregular Valleys.

Required: 1st, The length of the run of the short valley; 2nd, the length of the short valley; 3rd, the length of the long valley, which is obtained by proportion.

As the short valley is to the ridge, so the long valley is to half the span of the main building.

Main Building		Intersecting Building		
Span.	Rise.	Span.	Rise.	Ridge.
16′	5′	5′ 6″	4′	6′ 4 3-4″
30′	15′	12′	8′	8′
18′	12′	10′	6′	4′ 6″
18′	10′	18′	8′	7′ 2 3-8″
21′	9′	14′	6′ 6″	7′ 7″
40′	16′	21′	12′	15′
26′	12′	13′	7′	7′ 7″
38′	16′	17′	10′	11′ 10 1-2″
28′	13′	16′	9′	9′ 8 5-16″

Short Valley.		Length of Long Valley.
Run.	Length.	
6′ 11 5-8″	8′ 0 3-8″	10′ 1-2″
10′	12′ 9 11-16″	24′ 1-8″
6′ 8 3-4″	9′ 3-16″	18′ 5-16″
11′ 6 5-16″	14′ 3-8″	17′ 6 1-2″
10′ 3 13-16″	12′ 2 3-8″	16′ 10 5-8″
18′ 3 3-4″	21′ 10 11-16″	29′ 2 1-4″
9′ 11 7-8″	12′ 2 3-8″	20′ 10 7-8″
14′ 7 1-4″	17′ 8 3-8″	28′ 3 3-4″
12′ 6 3-4″	15′ 5 7-16″	22′ 3 15-16″

Answers.

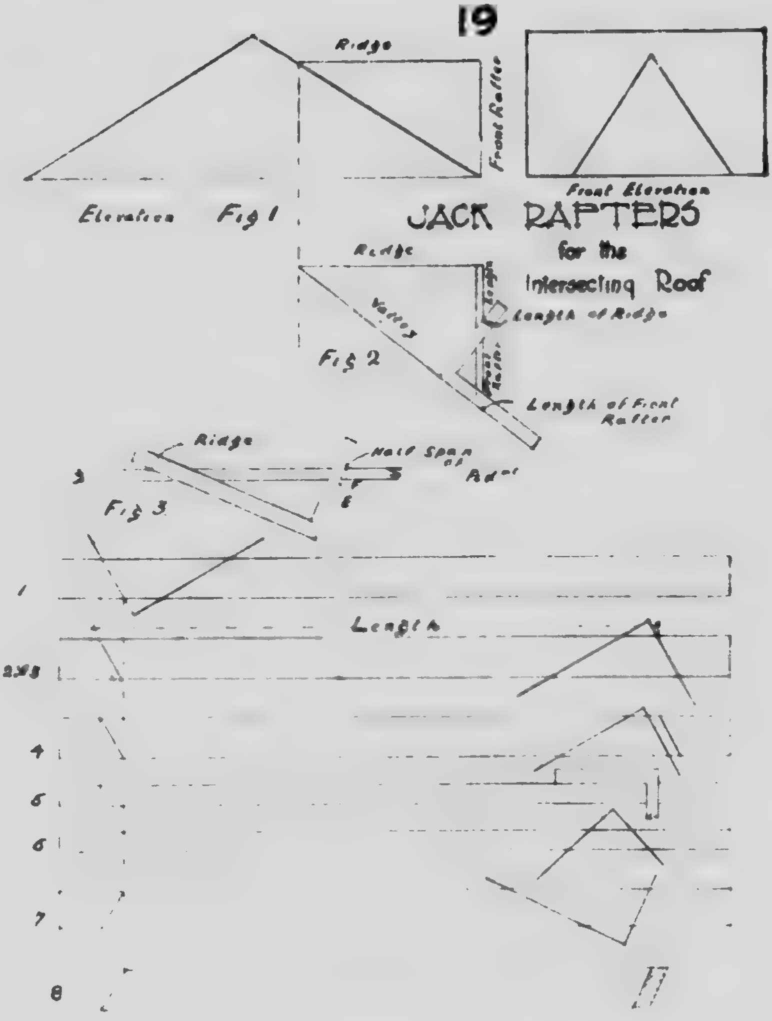
No. 13.

Irregular Valleys.

Required, the amount to recede square from the plumb line for long and short splays. These splays apply both to the valleys and to the jack rafters. To obtain this see Fig. 4½.

Half Span.	Ridge.	Long Splay.	Short Splay.
6′	8′	2 8-12″	1 1-2″
5′	4′ 6″	2 3-16″	1 13-16″
9′	7′ 2 3-8″	2 1-2″	1 5-8″
7′	7′ 7″	2 3-16″	1 7-8″
10′ 6″	15′	2 7-8″	1 3-8″
6′ 6″	7′ 7″	2 3-8″	1 3-4″
8′ 6″	11′ 10 1-2″	2 13-16″	1 7-16″
8′	9′ 8 5-16″	2 7-16″	1 5-8″

Answers.



JACK RAFTERS FOR THE INTERSECTING ROOF AS IN PROBLEM VI.

Lecture.

(1.) The following description is applied to the plan method of laying out work, combined with the application of the steel square method.

(2.) As has been mentioned before, in cases where an angle is to be obtained, always look for the right angled triangle.

(3.) To begin with, we will take the pediment jacks, and for this purpose we must find the right angled triangle to be filled in with these jacks.

(4.) Now this will be the surface of the side of the pediment, and this surface is bounded by three lines which are: the front rafter, the ridge, and the valley.

(5.) These three lines form a right angled triangle, the right angle being at the point where the front rafter and the ridge join.

(6.) Therefore, all that is required is to know the length of the ridge and the front rafter.

(7.) The angle for the splay cut at the foot of the jacks is that formed by the lower end of the rafter and the valley, and is marked by applying the square to the scantling with the length of the ridge and the length of the front rafter, marking on the side which contains the length of the front rafter.

(8.) Allowance must be made for half the ridge at the top, and half the valley at the bottom. See Fig. 6, Plate 16.

Formula.

(1) Mark the point cut.

(2) Measure down the length, allowing for the ridge.

(3) Mark the plumb line.

(4) Recede for the half valley.

(5) Mark the square line across.

(6) Mark the splay. (See Fig. 2 of theory).

(7) Mark the plumb line on the other side.

(8) Complete jack showing splay cut.

No. 14.

Pediment Jacks for Irregular Valley Roofs.

Required, the diminishing length, and the figures to be used for the splay cut, the figure to be marked on, being put last.

Main Building.		Intersecting Building.	
Span.	Rise.	Span.	Rise.
30′	15′	12′	8″
18′	12′	10′	6′
18′	10′	18′	8′
21′	9′	14′	6′ 6″

Figures to be used for splay cuts.

Length of ridge. 8′	Length of front rafter. 10′	Diminishing Length of jacks. 20″
4′ 6″	7′ 9 3-4″	27 3-4″
7′ 2 3-8″	12′ 1-2″	27 3-4″
7′ 7″	9′ 6 5-8″	20 1 8′

Answers.

20

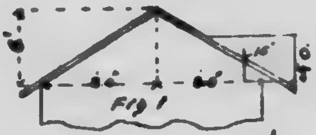


Fig 1

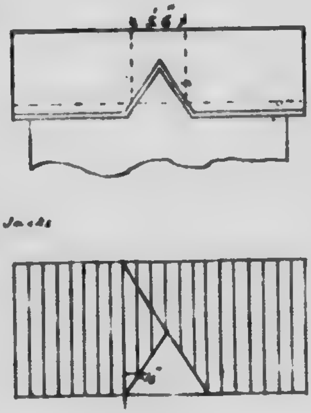
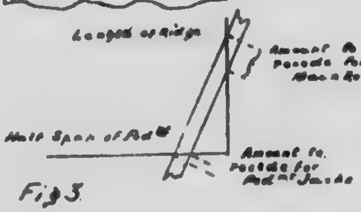


Fig 2


Length of Ridge
Amount to Deduct for Main Roof Jacks
Half Span of Add'l
Amount to Deduct for Add'l Jacks
Fig 3.

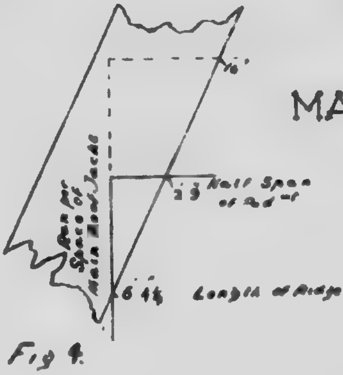
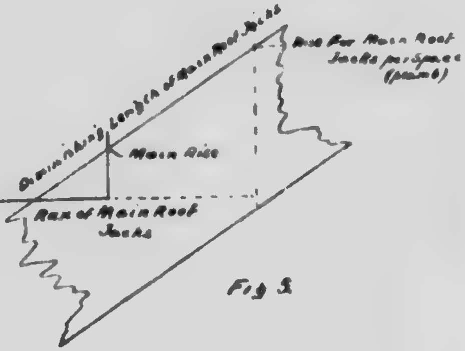


Fig 4.

MAIN ROOF JACKS

for

unequal valley roof


Diminishing Length of Main Roof Jacks
Rise for Main Roof Jacks per Space (plumb)
Main Rise
Run of Main Roof Jacks
Fig 5.

MAIN ROOF JACKS FOR UNEQUAL PITCHED VALLEY ROOF.

Lecture.

(1) To obtain the diminishing length of the jacks in the main roof requires one of the most complicated processes in this course.

(2.) Figure 1 shows the roof of problem 6 in plan.

(3.) In Figure 3 a scantling is lying in the same position as the valley, the square applied with the length of the ridge, and half the span of the pediment; this shows the amount to recede for both long and short splay.

(4.) To mark the diminishing length of these jacks requires four positions of the square which are shown in Figs. 4 and 5.

(5.) The first position is to place the square as in Fig. 4, with the length of the ridge and half the span of the pediment.

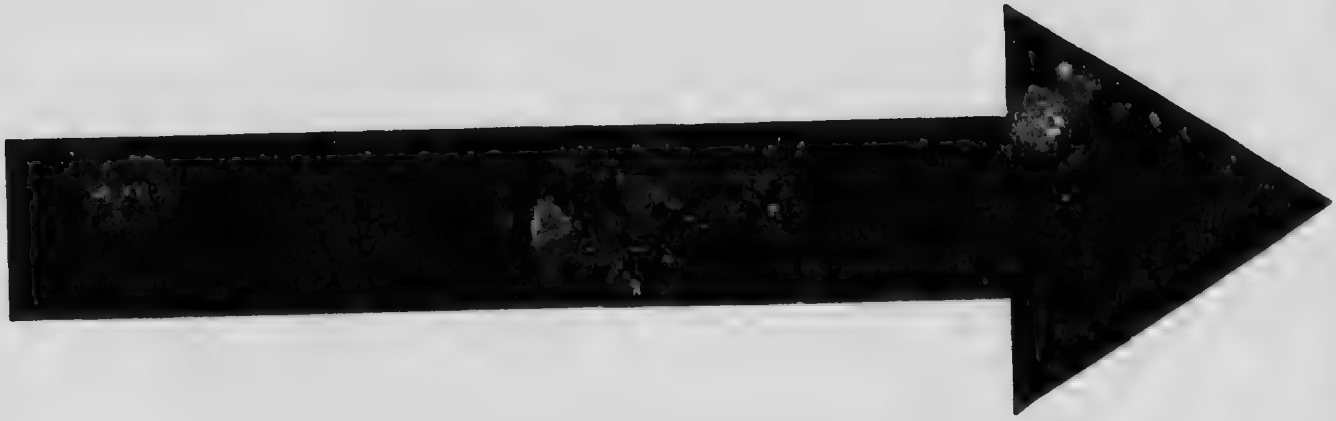
(6.) Then slide to 16″ as shown, which will be the same as 16″ in plan, Fig. 2, the other side will be the run per space as shown.

(7.) It then remains to find the rise on this run, with the main run and main rise.

(8.) For this purpose apply the square to a board as in Fig. 5, with the main run and main rise.

(9.) Then slide to the run obtained in Fig. 4, and as shown in Fig. 2, the rise will appear at the top as shown in Fig. 5.

(10.) Compare this position with Fig. 1 to see how this run and rise apply to the main common rafter.



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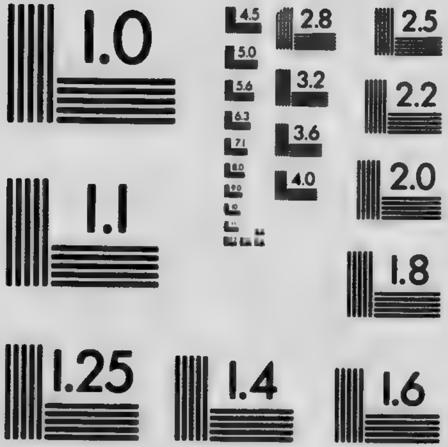
(ANSI and ISO TEST CHART No. 2)



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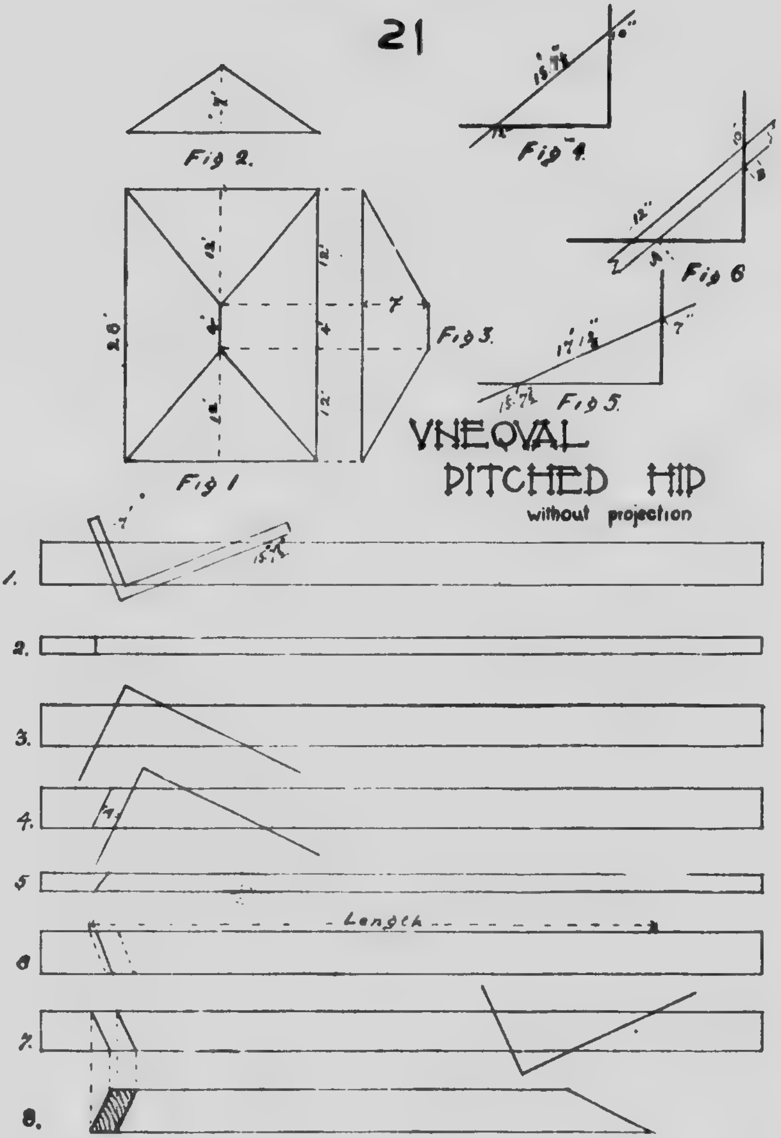
Section 7.

21



VNEQVAL
PITCHED HIP
without projection

UNEQUAL PITCHED HIP WITHOUT PROJECTION.

PROBLEM VII.

Figs. 1, 2 and 3 show a roof of unequal pitch without projection. All the data we require in order to lay out these hip rafters, will be as follows:—

Statement.

(1) Span.

(2) Distance from the end of the ridge to the end of the building.

(3) Rise.

Essentials.

(1) Half span.

(2) Distance from the end of the ridge to the end of the building.

(3) Run of hip.

(4) Length of hip.

(5) Rise.

(6) Amount to recede for splay.

Explanation.

(1) To find the run of the hip, measure from 10′ to 12′. Fig. 4.

(2) To find the length of the hip, measure from run to rise. Fig. 5.

(3) To find the amount to recede for the splay, apply the square to a scantling with the half span and end run 10′ and 12′. See Fig. 6.

(4) Recede the amount A. for the long splay, and the amount B. for the short splay.

Formula.

(1) Mark the plumb cut.

(2) Mark square across the top.

(3) Mark the plumb line on the other side.

(4) Recede and mark the plumb line for the splay.

(5) Mark the splay on the top.

(6) Measure down the length, allowing for the ridge.

(7) Mark the seat line.

No. 15.

Irregular Hip Roofs.

Required, Run of hip; Length of hip; Amount to recede square from the plumb line for both long and short splays.

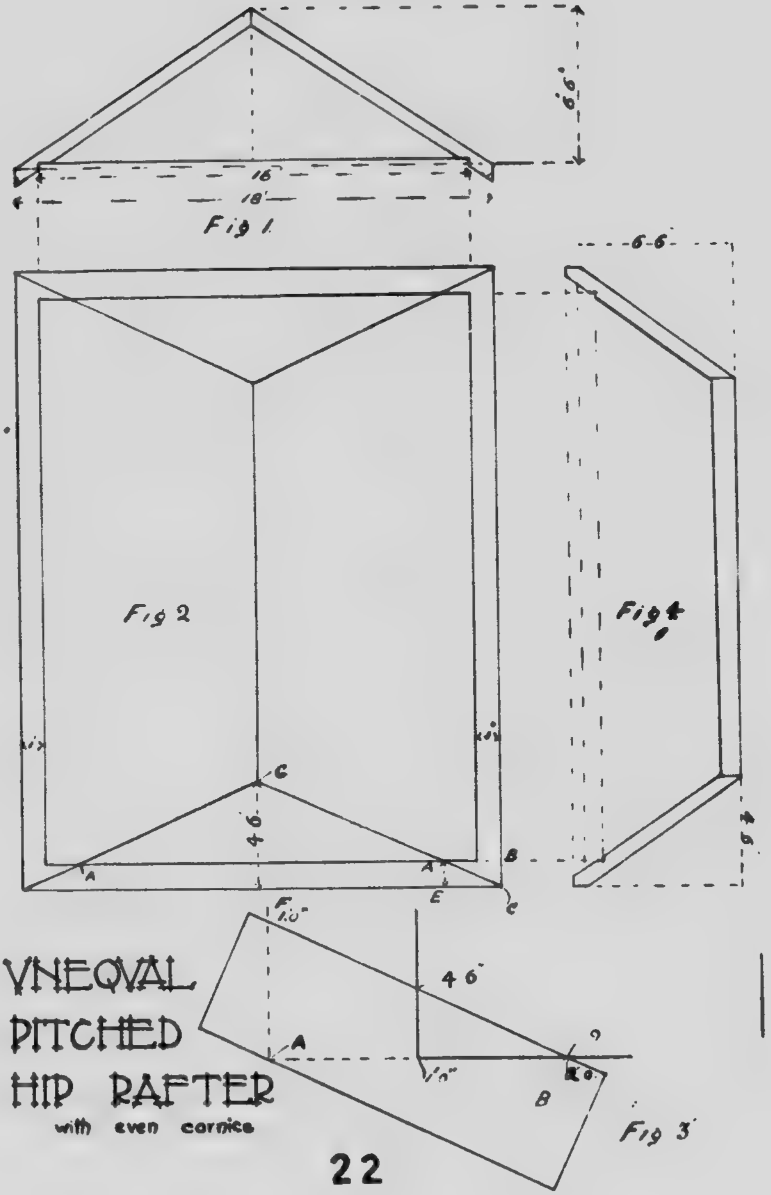
Span.	Rise.	Distance of ridge from end of building.	Run of hip.
16′	6′	4′	8′ 11 5-16″
16′	7′	5′	9′ 5 3-16″
16′	8′	6′	10′
13′	6′	7′	9′ 6 5-8″
20′	9′	11′	14′ 10 3-8″
17′	7′	9′	12′ 4 9-16″
23′	11′	9′	14′ 7 1-4″
19′	6′ 6″	7′	11′ 9 5-8″
7′	3′ 2″	15′	15′ 4 13-16″
32′	12′ 8″	10′	18′ 10 7-16″
40′	14′ 6″	16′	25′ 7 3-8″

Answers.

Length of Hip.	Amount to recede	
	Long Splay.	Short Splay.
10′ 9 1-4″	4″	1″
11′ 9″	3 1-4″	1 1-4″
12′ 9 11-16″	2 8-12″	1 1-2″
11′ 3 3-8″	2 1-8″	1 7-8″
17′ 4 1-2″	2 1-4″	1 3-4″
14′ 2 5-8″	2 1-8″	1 7-8″
18′ 3 3-8″	2 9-16″	1 9-16″
13′ 5 5-8″	2 3-4″	1 1-2″
15′ 8 11-16″	8 1-2″	1-2″
22′ 8 11-16″	3 3-16″	1 1-4″
29′ 5 3-16″	2 1-2″	1 5-8″

Answers.

Section 8.



VNEQVAL
PITCHED
HIP RAFTER
with even cornice

UNEQUAL PITCHED HIP ROOF WITH EVEN CORNICE.

Lecture.

(1.) The problem of the roof shown in Plate 22, requires to be divided into four parts, namely these:

(First) The plate.

(Second) The common rafters for both sides.

(Third) The hip rafters.

(Fourth) The jack rafters.

(2.) The first three of these are taken up in order; the fourth, relating to jacks, having been covered before, is merely touched upon, the application of the splay cuts being shown in Plate 27, and the rule for applying the square given at the end of the lecture.

(3.) The problem of the unequal pitched hip roof is in some respects the same as the unequal pitched valley roof.

(4.) In so far that we measure from the great run to the lesser run on the square to find the run of the hip, and also the splay cuts are found in a similar manner.

(5.) But one noteworthy difference exists; that the hip jacks may have a projection, and the valley jacks never have.

(6.) In the even pitched roof this was very little more trouble, as the common rafter pattern answers for marking the lower end of all the jacks, but in this unequal pitched hip roof the pattern for side rafters is materially different from the end pattern.

(7.) And probably to lay out these two patterns, will be the best place to begin to lay out this roof.

(8.) In the foregoing examples there has been little importance attached to the amount of the hip projection, as in fact in many cases it can be dealt with to better advantage after the other rafters have been raised. But as in this case the layout of our work depends upon the amount of the projection, it is essential that we receive a statement of the width of the cornice as well as the rise and both runs before we can do anything.

(9.) For example, take a roof with a span of 16′ and a projection of 1′ which makes a span of 18′ over all.

(10.) The entire rise from the top of the facia to the top of the ridge is 6′ 6″.

(11.) At the end the run is 3′ 6″ and this with the 1′ 0″ projection makes the entire run 4′ 6″.

(12.) For reasons which will be apparent, we will take all the rafters as extending from the facia to the ridge and lay out the bird's mouth for the plate as a secondary consideration.

(13.) A diagram showing the comparative pitches of the side and end rafters, and the position of the bird's mouth, is shown in Fig. 6, Plate 23.

(14.) By this it will be seen how much higher one plate is than the other.

(15.) Otherwise this can be found out by the projection with the square, as shown in Figs. 4 and 5, Plate 23.

(16.) The first case is taken in Fig. 4, which shows that in the 1′ cornice the rise is 8¾″.

(17.) In Fig. 5 the rise in the width of the cornice is 1′ 5¼″. Therefore the difference is 8½″, which will be the amount that the plate on the steeper side is higher than the other.

(18.) Another important point should be dealt with before laying aside the question of the different plates.

(19.) Fig. 2, Plate 22, shows that the hip does not even pass over the corner of the building at the face of the wall, but falls a considerable distance short on the steeper side.

(20.) It is therefore important to know this amount, as it designates the position of the hip.

(21.) So to determine how far this point is from the facia or the distance A. to B., Fig. 2, Plate 22.

Apply the square to a board as shown in Fig. 3, with the two runs which are 9′ and 4′ 6″. Plate 22.

(22.) Slide the square to 1′ on the tongue and you have the triangle similar to A.E.C., Fig. 2, and the blade will show a distance equal to E.C., Fig. 2, which is the distance from the side facia to mark the end plate.

(23.) The length of the hip is from the end of the ridge to the intersection of the facia boards.

(24.) Therefore the run of the hip is from a point immediately under the end of the ridge, to the intersection of the facia boards.

(25.) So to find the run of the hip, measure from the great run to the lesser run, in this case from 9′ to 4′ 6″, which is found to be 10′ 0 ¾″.

(26.) With the run 10′ 0 ¾″ and the rise 6′ 6″ the length of the hip is 11′ 11 ¾″. See Fig 5, Plate 28.

(27.) Now observe that we have enough information to lay out the plumb cut at the point of the hip, and to lay out the splay, which will be the short one according to Fig. 4, Plate 28, and also to measure the length and mark the plumb line for the facia.

(28.) For further proceedings see the formula and work movements.

(29.) The amount to recede for the splay cut of the end jacks is shown at A., Fig. 9, Plate 23, and the amount for the side jacks at K., the square being applied with the greater and lesser runs, 9′ and 4′ 6″.

(30.) As the matter of splay cuts has been treated before, we will just show the development of the splays from the horizontal measurements which will assist the student to comprehend their nature and form developments for himself. See Fig. 10, Plate 27.

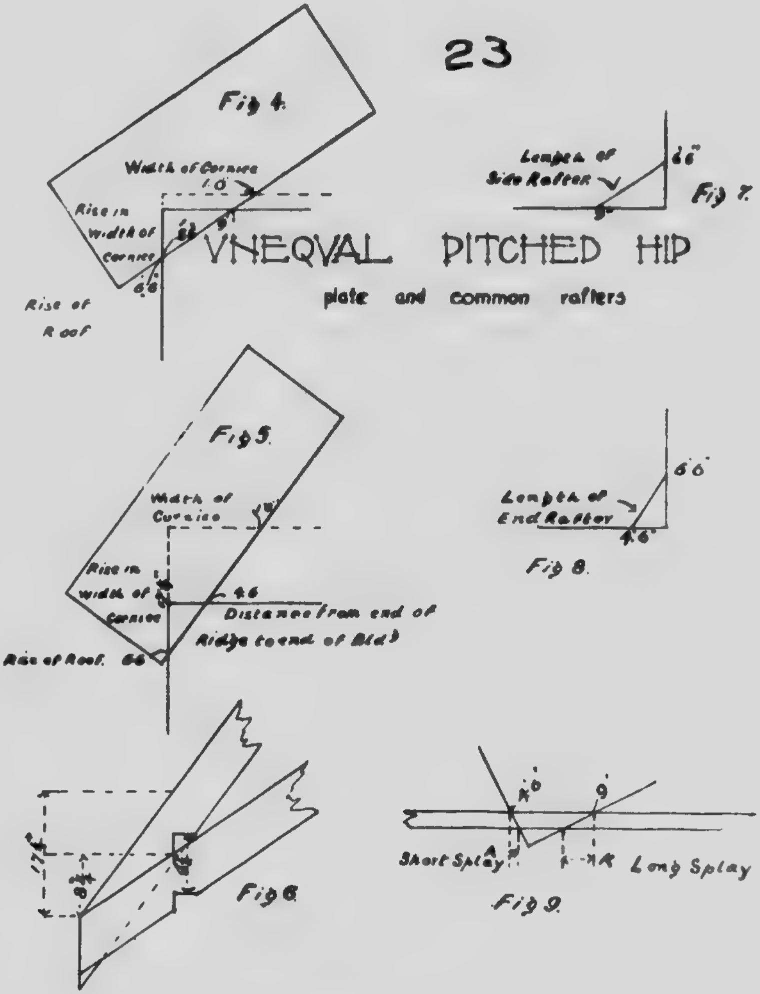
(31.) Before applying the rule for marking the splay cut on the top edge of these jacks it will be well to notice that there are triangles of two dimensions in this roof, one for the side and one for the end.

(32.) For the side take the length of the full lengthed rafter and the distance from that rafter to the end of the building, apply the square with these lengths and mark on the length of the rafter.

(33.) For the end rafter take the length of the centre rafter and the distance from it to the corner of the building; mark on the length of the rafter.

(34.) The diminishing length can always be found by working the rule given for pediment jacks, i.e., proportion.

23



VNEQVAL PITCHED HIP

plate and common rafters

PROBLEM VIII.

Hip With Projection.

THE PLATE.

The plate will be considered in the three different stages similar to those of the rafter problems.

The requirements of this problem being to find out the length of the end plate and its height above the side plate.

The statement for this problem requires these points:—

Statement.

The entire rise from cornice to ridge; see 6′ 6″ in Fig. 4, Plate 22.

The great run.

The lesser run.

The width of cornice.

Essentials.

The essentials for laying out the work are these:

(1) The length of the upper plate.

(2) Height above the lower plate.

Explanation.

(1) To obtain these we will first consider the difference in height, and for this purpose will consider the two common rafters at their respective

(2) If a drawing of this kind is made it is easy to pitches as shown in Fig. 6, Plate 23. measure upon it the difference in height of these two plates.

(3) Now, we are treating this with the square alone, therefore we will follow the method shown in Figs. 4 and 5, Plate 23.

(4) First apply the square as in Fig. 4, with the great run and the rise, and slide it up to the width of the cornice, in this case showing a rise of 8¾″. Secondly apply the square with the lesser run and rise, Fig. 5, and slide again to the width of the cornice, and in this case the rise is 17¼″. This shows the difference to be 17¼″ minus 8¾″ which equals 8½″ for the difference in height of plates.

METHOD NO. II. FOR FINDING THE DIFFERENCE IN HEIGHT OF PLATES IN ROOFS OF DIFFERENT PITCHES.

(1.) In this problem the most important essentials will be:—

(1st) The amount that one plate is higher than the other, and

(2nd) The distance from the corner of the building to the point at which the hip passes over the plate.

(2.) Seeing that the end rafter rises so much more in the width of the cornice than the side rafter, it will require that the end plate shall be just so much higher than the side plate.

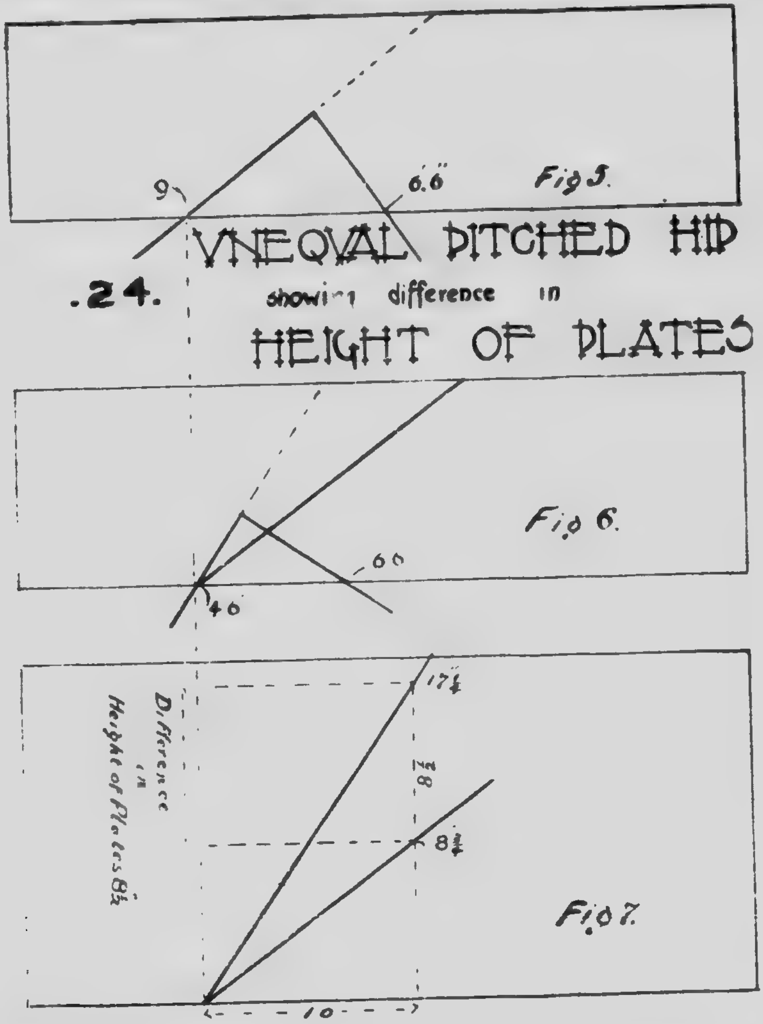
(3.) To obtain the amount that one plate is higher than the other, we may proceed as shown in Figs. 5, 6 and 7, Plate 24.

(4.) In Fig. 5, the square is placed at the lesser pitch, which pitch line is to be extended as shown by the dotted lines.

(5.) In Fig. 6, the square is placed at the lesser pitch intersecting at the same point at the edge of the board, this line also is to be extended as shown by the dotted line.

(6.) From the point of intersection, Fig. 7, proceed the distance of the width of the cornice as shown by the 1 ft. mark. From this point erect the line A.B.

(7.) On this line, the distance between the two pitch lines will be the difference in height of plates.



.24.

UNEQUAL PITCHED HIP showing difference in HEIGHT OF PLATES

No. 16.

Irregular Hip Roofs.

Required, the rise per width of cornice, both for for side and end; the difference in height of plates; and the distance from the end of the upper plate to the projection of the common rafter on the other side.

Measurements over all:—

Span.	Rise.	Distance of ridge from end of building.	Width of cornice.
16′	6′	4′	1′
20′	9′	11′	1′ 6″
17′	7′	9′	1′

Rise per width of cornice. end.	Rise per width of cornice. side.	Amount that one plate is higher than the other	Distance from end of upper plate to projection of lower com. rafter.
1′ 6″	9″	9″	2′
1′ 2 3-4″	1′ 4 3-16″	1 7-16″	1′ 7 13-16″
9′ 3-8″	9′ 7-8″	1-2″	1′ 11-16″

Answers.

COMMON RAFTERS.

Statement.

(1) The great run over all.
(2) Lesser run over all.
(3) Rise.
(4) Width of cornice

Essentials for Both Side and End Rafters.

(1) Great . over all.
(2) Lesser run over all.
(3) Rise over all.
(4) Length of rafters for both side and end.
(5) Width of cornice.
(6) Rise per width of cornice in both cases.

Explanation.

To obtain the points which are not contained in the statement:—

(1st) The length of the rafters will be found by measuring from run to rise in the usual way. (2nd) For the rise per width of cornice, see Figs. 4 and 5, Plate 23 and Method No. 2.

Formula.

This formula answers for both side and end rafters and applies to the full length in both cases.

(1) Mark the point cut.

(2) Measure down the entire length, allowing for the ridge.

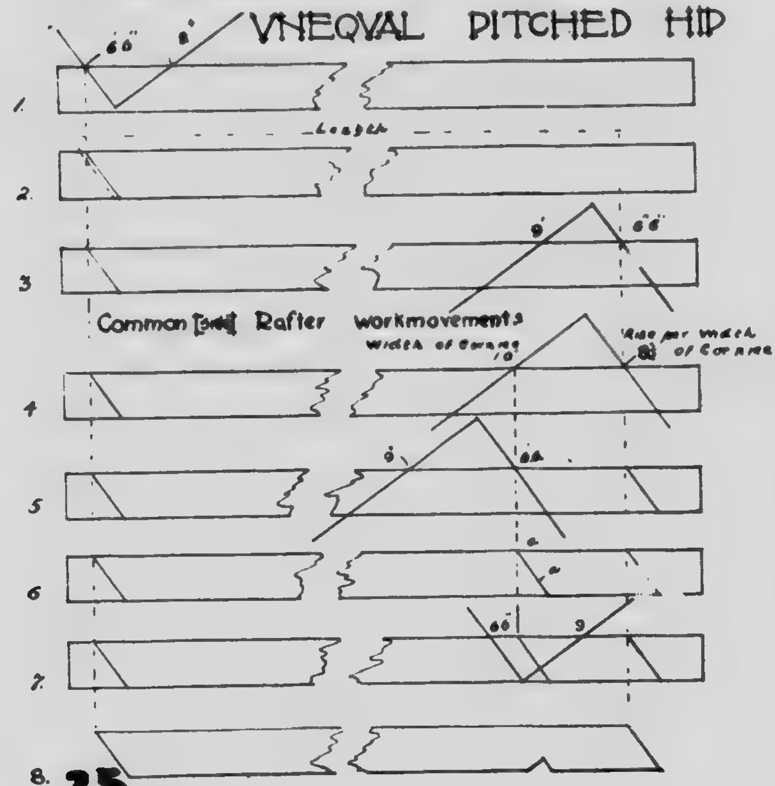
(3) Mark the plumb cut for the facia.

(4) Recede the amount of the projection.

(5) Mark the plumb line for the face of the wall.

(6) Mark the depth of the sizing, A. to A.

(7) Mark the seat line.



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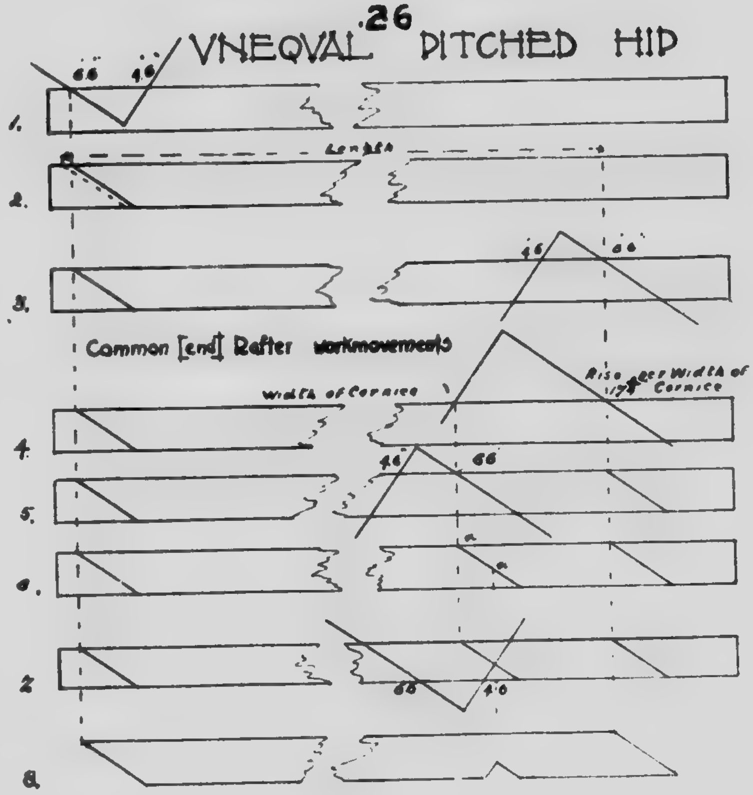

.26
VNEQVAL PITCHED HIP
6.6
4.6
1.
Length
2.
4.6
6.6
3.
Common [end] Rafter workmovements
Width of Cornice
Rise per Width of
17 Cornice
4.
4.6
6.6
5.
a
a
6.
7
6.6
4.6
8.

SPLAY CUTS OF JACK RAFTERS

.27.

in unequal pitched roof

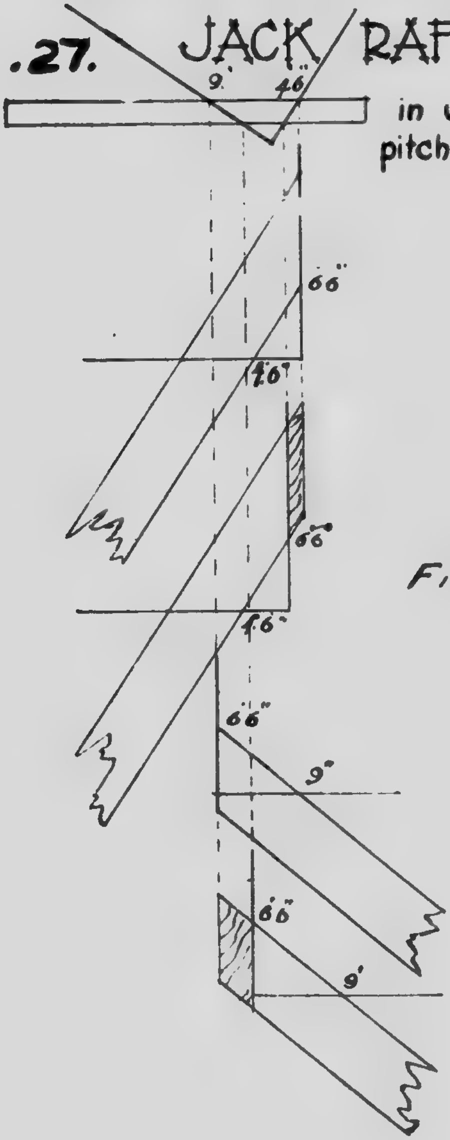
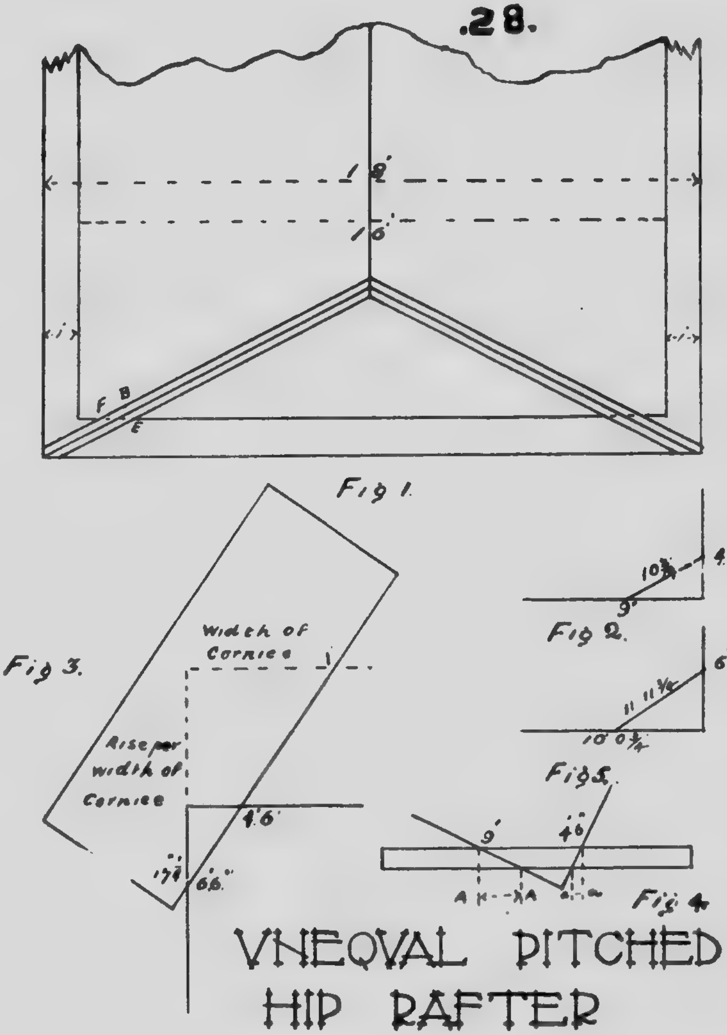


Fig 10.


.28.
1 8'
1 6'
1'
1'
F
B
E
Fig 1.
10¾
4'6"
9'
Fig 2.
6'6"
11 11¼
10' 0¾
Fig 5.
Width of Cornice
1
Fig 3.
Rise per width of Cornice
4'6"
17⅛
6'6"
9'
4'6"
A
A
a
a
Fig 4
VNEQVAL PITCHED HIP RAFTER

HIP RAFTER.

In this most complicated problem it will be seen that there is a great advantage in proceeding as we have done in all cases, with the work divided into three stages, so that in all cases we shall know just those points we must have in the statement, without being encumbered with things that are not needed.

And having this statement we will proceed to obtain the essentials for the work on the scantling.

For the statement of the points necessary for the hip rafter in the unequal pitched roof having an even cornice, the measurements already given for the common rafter will be sufficient.

The points are these:—

Statement.

(1) Rise from facia to ridge, 6′ 6″.
(2) Great run over all, 9′.
(3) Lesser run over all, 4′ 6″.
(4) Width of cornice, 1′.

Essentials.

(1) The entire rise.

(2) The entire run of the hip from the top of the facia to under the point of the ridge.

(3) The length of the hip over all.

(4) The amount to recede for both long and short splays.

(5) The amount that the roof rises in the width of the cornice on the steep side.

(6) Projection of the hip.

Explanation.

(1) To obtain these essentials let us take them in the order stated.

(2) The rise is generally obtained by measuring the drawing of the building if not otherwise stated.

(3) The entire run of the hip can be obtained by measuring from the greater to the lesser run. Fig. 2, Plate 28.

(4) For the length of the hip, measure from run to rise. Fig. 5, Plate 28.

(5) The amount to recede is found by applying the square to the edge of a scantling as shown in Fig. 4, with the greater and lesser runs. Plate 28.

(6) The distance A.A. and a.a., Fig. 4 will show how much to recede for long and short splays.

(7) To find the rise per width of cornice in the steep side, apply the square to a board with the rise and lesser run as in Fig. 3, Plate 28.

Slide up until the width of the cornice on the tongue of the square comes to the edge of the board, the blade will show the amount of the rise.

(8) To find the projection of the hip rafter, refer to Fig. 2 in Plate 22; take the distance B.A. and the distance E.A., measure from one to the other which will be in this case from 1′ to 2′ and will equal 2′ 2 7-8″ as used in Fig. 8 of the work movements.

UNEQUAL PITCHED HIP RAFTER HAVING EVEN CORNICE.

Formula.

(1) Mark the point cut.

(2) Mark square across the top.

(3) Mark the plumb line on the other side.

(4) Recede the required amount and mark the second plumb line on that side.

(5) Mark the splay cut on the top.

(6) Measure down the length.

(7) Mark the plumb cut for the facia.

(8) Slide the square up and mark the position of the wall line. See distance A. to C., Fig. 2, Plate 22.

(9) Mark the wall line.

(10) Measure down and mark the sizing a. to a. according to the common rafter.

(11) Mark the seat line.

(12) Mark square across the top.

(13) Mark the plumb line on the other side at E., Fig.1, Plate 28.

(14) Proceed from B. the amount of the long splay and mark the plumb line at F., Fig. 1, Plate 28.

(15) Mark the line from E. to F. See Plate 28 on the bottom, and cut on that line. See Fig. 1.

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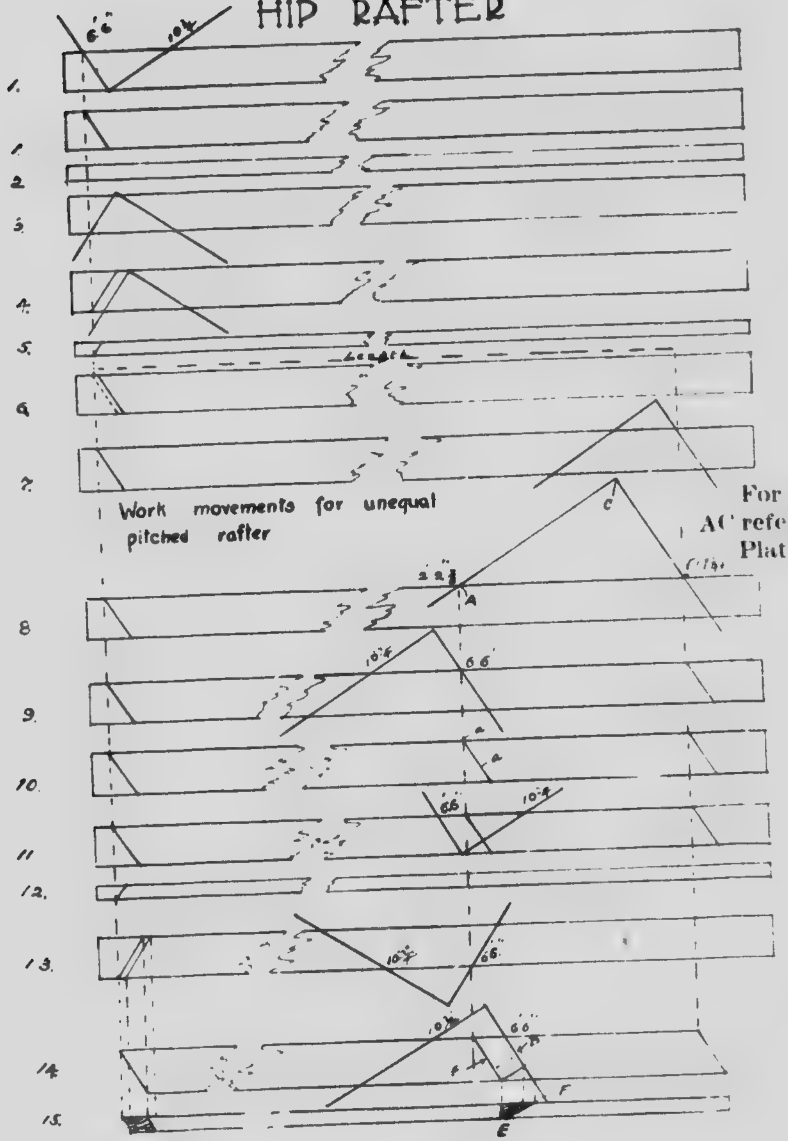
HIP RAFTER



For length AC refer to Plate 22

No. 17.

Irregular Hip Roofs.

Required: The amount that the hip recedes from the corner of the building. The projection of the hip, and the figures to be used for obtaining splay cuts.

Span.	Distance of ridge from end of building.	Figures to be used for obtaining splay cuts.	
16'	4'	8'	4'
20'	11'	8'6"	9'
17'	9'	10'	11'

Answers.

The amount that the hip recedes from the corner of the building	Projection of hip.
1' 0"	2' 2 7-8"
0' 1 13-16"	2' 2 3-4"
0' 11-16"	1' 5 1-2"

No. 18.

IRREGULAR HIP ROOFS.

Required: Run of hip, and length of hip: measurement over all.

Side run	End run	Rise	Run of hip	Length of hip
8'	4'	6'	8' 11 3-8"	10' 9 1-4"
10'	11'	9'	14' 10 3-8"	17' 4 1-2"
6' 6"	9'	7'	11' 1 1-4"	13' 1 1-2"

Answers.

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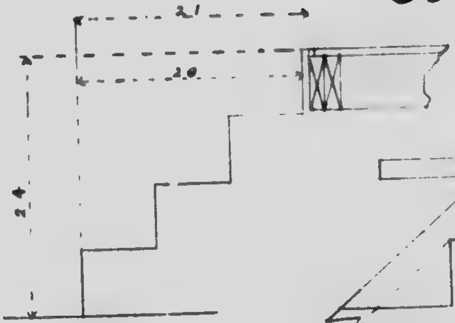


Fig 1.

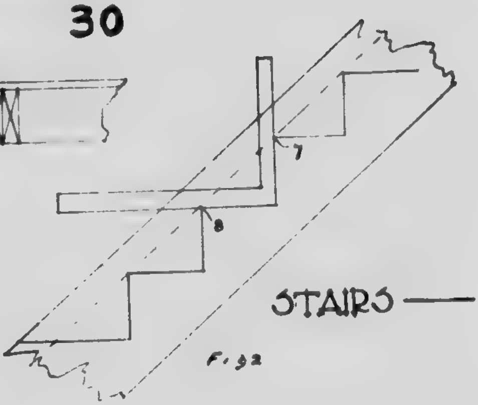


Fig 2

STAIRS —

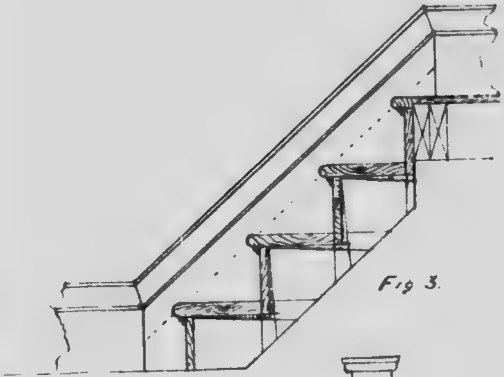


Fig 3.

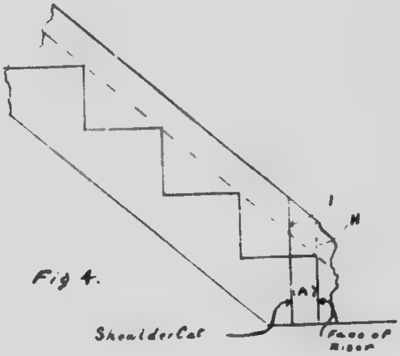


Fig 4.

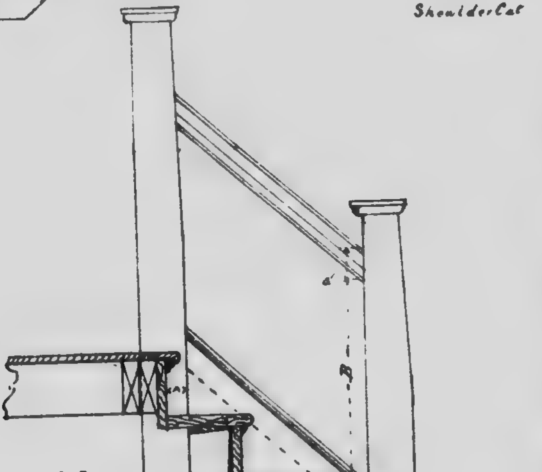


Fig 5.

See Section 9

Section 9.

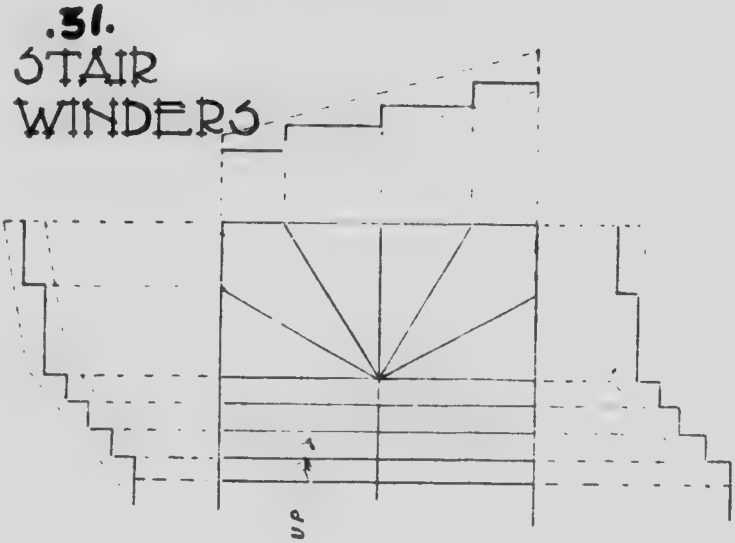


Fig 6.

STAIRS.

Lecture.

(1.) The height to be climbed is called the rise.

(2.) The distance to be travelled is called the run.

(3.) The right way to consider stairs is always to think of the treads and risers first.

(4.) If the treads and risers are properly designed, the strings can then be arranged.

(5.) Fig. 1 shows the lines representing the top of the treads and the face of the risers.

(6.) Figure 2 shows the square applied to one of the strings with 7 inch rise and 8 inch go.

(7.) Figure 3 shows a section through the treads and risers.

(8.) It will have been seen that the theory of this system is principally in connection with the essentials.

(9.) The statement is merely the order for the article required and contains nothing more than a description of what is wanted.

(10.) The formula consists of a set of rules for the physical performance of a certain piece of work.

(11.) But the essentials require thought, judgment and decision, the faculty for design and that store of information which makes a man qualified to handle the cases which come before him under all their varying conditions, and virtually to arrange his own formula for carrying it out.

(12.) It will be noticed that in plain stairs the chief essentials are the height of each riser and the width of each go.

(13.) How often will you hear it remarked by the uninitiated, "I wish I could figure out these stairs," and at the same time he does not recognize that the chief difficulty before him does not lie in the question of the figures.

(14.) The greatest mathematician in the country would be at a loss to figure out a set of stairs if he did not understand the leading principles which govern the design of stairs.

(15.) In this case calculation is servant to design, and an indespensable servant at that.

(16.) The design of stairs is embodied in this one sentence.

(17.) To decide the number of risers and treads according to the best rise and go that can be obtained.

(18.) For this purpose we make use of Arithmetic.

(19.) Assuming a certain number of risers we try it out and see if it gives a suitable height of riser and width of go, and if it does not suit us we try the next one to it, greater or less as the case may be, till we arrive at the riser and go which suits us best.

(20.) For the purpose of demonstrating this principle let us take a case and deal with it in such a way as to show what this principle consists of.

(21.) A rise of 8′ and a run of 8′ will be a simple case, and to demonstrate the central fact let us take the two extremes.

(22.) First let us assume that there will be six risers that will give a rise of 16″ and a go of 19 3-16″. No one would have such a rise as that unless for a fireman's ladder. Secondly, let us fly to the other extreme, and try it out with 20 risers, which would give a rise of 4 7-8″ slack and a go of 5 1-16″ slack. No one would have such a stair as that.

(23.) Now the object of stating these extremes is this, that we know that the correct number must be somewhere between them, and our object is to avoid the extreme in either direction.

(24.) Therefore, if a man were to figure out every case between these two, one of them would be the right one, and having all these examples before him, he could surely decide which he would choose to have.

(25.) See therefore how impossible it is for a man to decide a question unless the case is laid before him.

(26.) But we have a shorter method of laying out our case than the one stated, though it is based on the same principle, instead of beginning at the outside, we begin at the centre.

(27.) As 7″ is a very serviceable riser we try it out with 7″ in this way.

(28.) 8 feet equals 96 inches. 7 inches goes into 96 inches thirteen times. So we assume 13 for the number of risers.

```
7)96(13
  7
  ——
  26
  21
  ——
   5
```

(29.) This gives a riser of 7 3-8″. The treads are always one less in number than the risers. Therefore there will be 12 treads of 8″, which will most probably be our choice.

```
13)96(7
   91
   ——
    5
   16
   ——
   30
   5
13)80(6
   78
   ——
    2
```

Ans. 7 3-8

(30.) But to make sure of this, take one less riser and see the result. In this case we have a riser of 8″ and a go of 8 3-4″ bare.

```
12)96(8        Ans. 8″
   96
   ——

11)96(8
   88
   ——
    8          Ans. 8 11-16
   16          or  8 3-4 bare.
   ——
   48
   8
   ——
11)128(11
   11
   ——
    18
    11
    ——
     7
```

(31.) Again try one more than the first case which will be 14 risers.

```
14)96(6                      13)96(7
   84                           91
   ——                           ——
   12        Ans. 6 7-8          5         Ans. 7 3-8
   16                           16
   ——                           ——
   72                        13)80(6
   12                           78
   ——                           ——
14)192(13                        2
   14
   ——
    52
    42
    ——
    10
```

Which gives a riser of 6 7-8″ and a go of 7 3-8″.

(32.) Now set them in order as below and compare them.

(33.) And as a rule there will be no trouble in deciding which one to use.

No. of Risers.	No. of Treads.	Height of each Riser	Width of each go.
12	11	8″	8 3-4″
13	12	7 3-8″	8″
14	13	6 7-8″	7 3-8″

NEWEL POSTS.

(1.) To ascertain where to mark the shoulder line of the string draw the riser line, H., right up across the string, Fig. 4.

(2.) From H., at a distance of half the thickness of the post, draw the line for the back of the newel post.

(3.) In the excercise the thickness of the rail is given and the width of the string, also the thickness of the shoe. These are to be considered as set in the stairs and their perpendicular depth taken. The baluster loses in length the amount of the splay at one end, which amount increases according to its thickness, therefore, the amount is stated in the exercise sheet.

Formula.

(4) Begin to lay out from the top of the post.

(5) Mark the space occupied by the rail A., Fig. 5.

(6) Measure down the length of the baluster B. minus the splay on one end.

(7) Mark the thickness of the shoe F. and descend the distance E. to the top of the tread.

(8) Lay out the tread E. and the riser H., the face of the riser being the centre of the post.

No. 19.

Newel Posts.

Required: The length from the top of the rail to the bottom of the string.

Rise.	Go.	Thickness of rail.	Balusters Length.	Balusters Thickness
7"	9"	3"	24"	7-8"
8"	7"	2"	22"	7-8"
7 1-2"	8 1-4"	2 1-2"	18"	7-8"

Thickness of shoe.	Width of string.	Length of newel post.
1-2"	10"	3' 4 3-8"
3-4"	10"	3' 4 1-2"
5-8"	10"	2' 11"

Answers.

PLAIN STAIRS PROBLEM.

For the statement of plain stairs there are certain things which can hardly be said to be necessary, but yet they form a part of the information which we must have in order to build stairs.

It goes without saying that the strings and treads will be 1 3-8", the risers 7-8", that the stairs will be wedged and that the string will intersect with the base at the top and bottom, that the upper floor will be fitted with a nosing and that the newel posts and rail will be made to conform to the situation.

Statement.

(1.) Rise from floor to floor.

(2.) Run from face of top riser to face of bottom riser.

(3.) Width over all from outside of one string to the outside of the other.

Essentials.

(1.) Height of each riser.

(2.) Width of each go.

(3.) The depth of the plinth of the base.

(4.) The distance from the nosing to the face edge of the string, or the distance of the sizing line from face edge of the string.

FORMULA FOR PLAIN STAIRS.

(1.) Mark the sizing line on the string 2½" from the face edge.

(2.) Apply the square with the rise and run to the sizing line as in Fig. 2.

(3.) Apply the tread templet to mark the housing.

(4.) Apply the riser templet.

(5.) Gage the bottom edge of the string ½" for the depth of the housing.

No. 20.

PLAIN STAIRS.

Required, to calculate the number of risers and treads, and to arrive at the most suitable height of riser and width of tread.

Rise.	Run.	Number of Risers.	Number of Treads.	Height of each Riser.	Go on each Tread.
8′	9′ 7-8″	14	13	6 7-8″	8 3-8″
9′	10′ 7 1-2″	16	15	6 3-4″	8 1-2″
10′	13′ 10″	17	16	7 1-16″	10 3-8″
8′6″	9′ 11″	15	14	6 13-16″	8 1-2″
9′6″	13′ 10″	17	16	6 23-32″	10 3-8″
10′8″	15′ 9″	19	18	6 3-4″	10 1-2″
11′8″	16′ 7 1-2″	20	19	7″	10 1-2″
12′	17′ 6″	21	20	6 27-32″	10 1-2″
16′	21′ 8″	27	26	7 1-8″	10″
5′3″	5′ 8″	9	8	7″	8 1-2″
4′2″	4′ 3″	7	6	7 5-32″	8 1-2″

Answers.

WINDING STAIRS.

(Note) The stairs should be designed before the building is put up, and the calculations must be made, and the measurements decided upon before the joisting is done.

(1.) Draw a full size plan as shown in Figure 6, Plate 31, developing the elevations on each side, and marking the strings on these elevations as shown in doted lines.

(2.) Cut all the pieces of the string so that they correspond with the drawing, and carry the marks on to them from the drawing for the treads and risers.

(3.) Usually it is best to set the upper piece of the string first and set the next one against it and so on down the stairs setting each piece against the one above it.

When there are three winders in a quarter turn, the width of the tread at the centre on the line of travel will be equal to a little less than a quarter of the width of the stairs.

In this we are assuming that the line of travel is on a line struck from the centre of the newel with a tramell half the length of the tread.

No. 21.

STAIR WINDERS QUARTER TURN.

Required, to calculate the number of risers in the entire height and to decide upon a number that will allow of the most suitable rise and go that can be obtained throughout the stairs.

Width of wall	Entire rise	Entire length of well	Height of each riser	Width of each plain go	Entire number of risers	Number of winders
2'8 3-4"	8'	10'	6' 7-8"	8 11-16"	14	3
3'	10'	11'	8"	8 23-32"	15	3
3'6"	10'6"	12'7"	7"	7 25-32"	18	3

Answers.

No. 22.

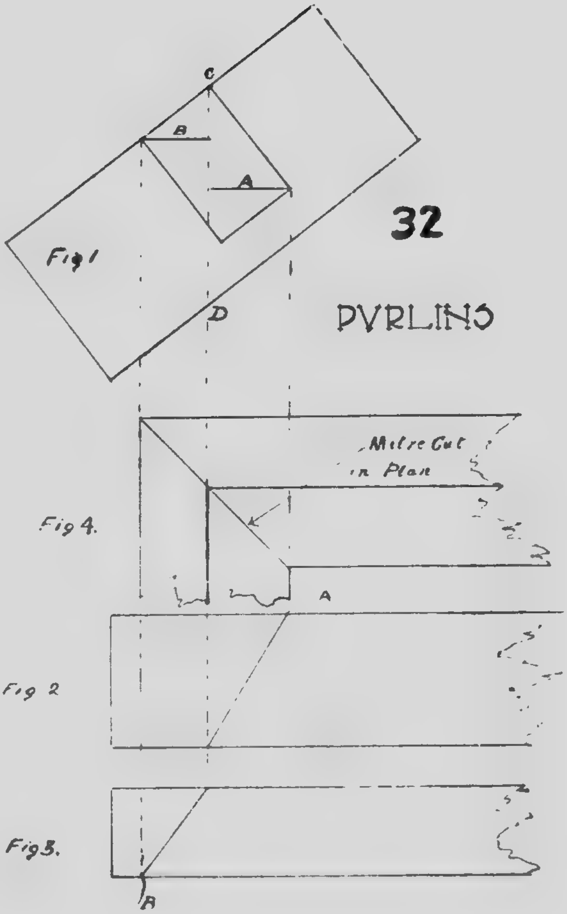
STAIR WINDERS HALF TURN.

Required, to calculate the number of risers in the entire height and moderate them so as to arrive at the best proportion between the height of the risers and the width of the treads.

Width of well	Run of plain stairs		Entire height	Height of each risers	Go on common treads	No of winders	No of risers
	Below turn	Above turn					
6'	3'1"	2'3 3-4"	8'2"	7"	9 1-4"	6	14
4'	2'4 7-8"	4'9 3-4"	9'4"	8"	9 5-8"	4	14
5'	2'8"	3'4"	9'4 1-2"	7 1-2"	8"	5	15

Answers.

Section 10.



PURLINS.

Miter Cut for the Purlins in the Even Pitched Roof.

Method 1.

Lecture.

(1.) All that is necessary is to mark an end view of the purlin on a board. A.B., Fig. 1.

(2.) Mark the plumb line of the common rafter C.D.

(3.) Mark a square line on the timber Fig. 2 and recede the distance A. equal to A., Fig. 1.

(4.) Proceed to the adjacent side, Fig. 3.

(5.) Proceed the distance B. equal to B., Fig. 1.

(6.) Each pair of opposite sides will be laid out with the same angle.

Miter Cut for the Purlins in the Even Pitched Roof.

Method 2.

(7.) It is a generally accepted rule that to mark the miter cut of a purlin the figures to be used on the square are.

(8.) (First) For the face that the rafters lie on, apply the length and run of the common rafter and mark on the length, and for the opposite side the same.

(9.) (Secondly) For the other face at right angles to this, apply the length and rise of the common rafter and mark on the rise, and on the opposite side the same.

(10.) The first of these, it will be noticed, is the same as the cut for the roof boards and lies in the same position.

(11.) The second of these, which is the angle for the side of the purlin which faces towards the ridge, if formed by applying the square with the rise and length of the common rafter, and this is the one which is so difficult to see.

(12.) Its chief peculiarity lies in the obscure position of this triangle.

(13.) As has been stated before, when an angle is to be laid out, the first thing to be done is to look for the triangle and ascertain the length of its sides.

(14.) Now at first sight it does not appear that there is any triangle which may be applied to mark this cut.

(15.) But as it has been already stated that the square applied with the rise and length of the common rafter will mark this angle, let us proceed to describe its position.

(16.) To do this we have to assume an unreasonable condition of affairs, which will be, that a purlin of 10″ square is to be placed in an even pitched roof with a span of 16′ and a rise of 6′.

(17.) Fig. 5 shows an elevation of this roof and Fig. 8 shows an end section of the purlin as set at the angle that it would occupy in the roof.

(18.) It will be seen that the side being 10′ on which the rafters lie, the amount to recede on that side for the splay will certainly be 8′, so that side contains the triangle of 8′x10′.

(19.) This side can be laid out with the same angle as the roof boards, with 8″ and 10″ and mark on the 8″ side.

(20.) Follow over the other side marked B., Fig 12, this also is 10″.

(21.) Now observe that this side projects inward 6″, see Figs. 8 and 10 which show that to mark the face B., Fig. 10 we must recede 6″.

(22.) Therefore the triangle marked E., Fig. 10 must be 10′ by 6′.

To prove this proceed to Figs. 13 and 14 and see how the square applies to these angles.

(23.) From this development it can be seen how this triangle always containing the rise and length of the common rafter applies to the upper face of the purlin.

(24.) The same principle applies to hoppers, though its application appears different.

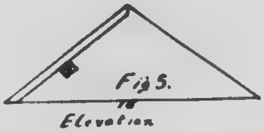


Fig 5.

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PVRLINS

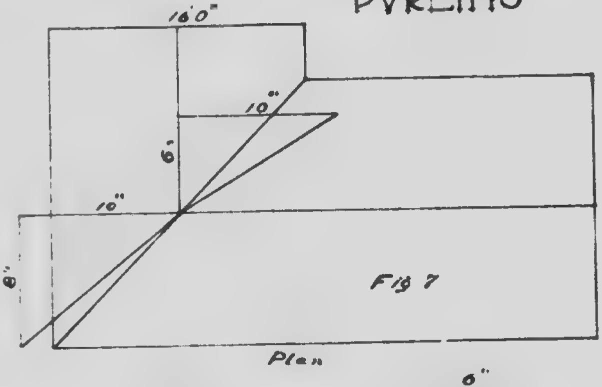


Fig 7

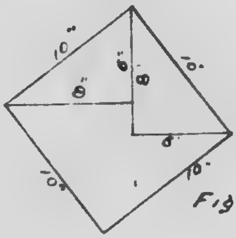


Fig 8

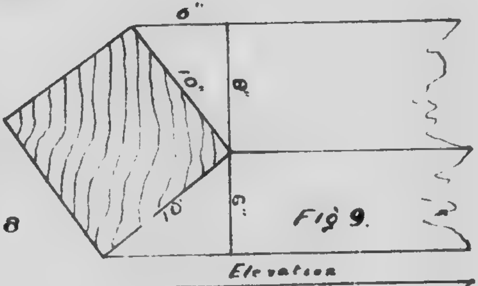


Fig 9.

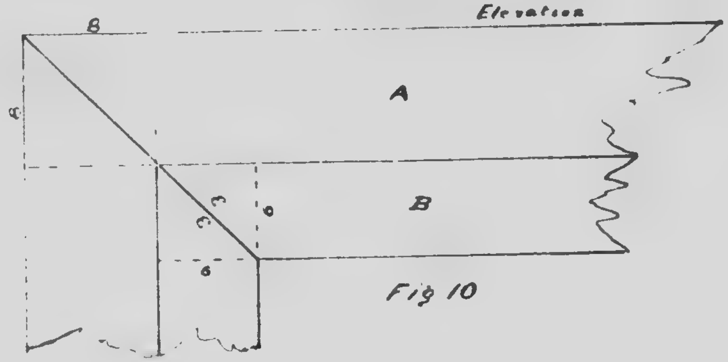
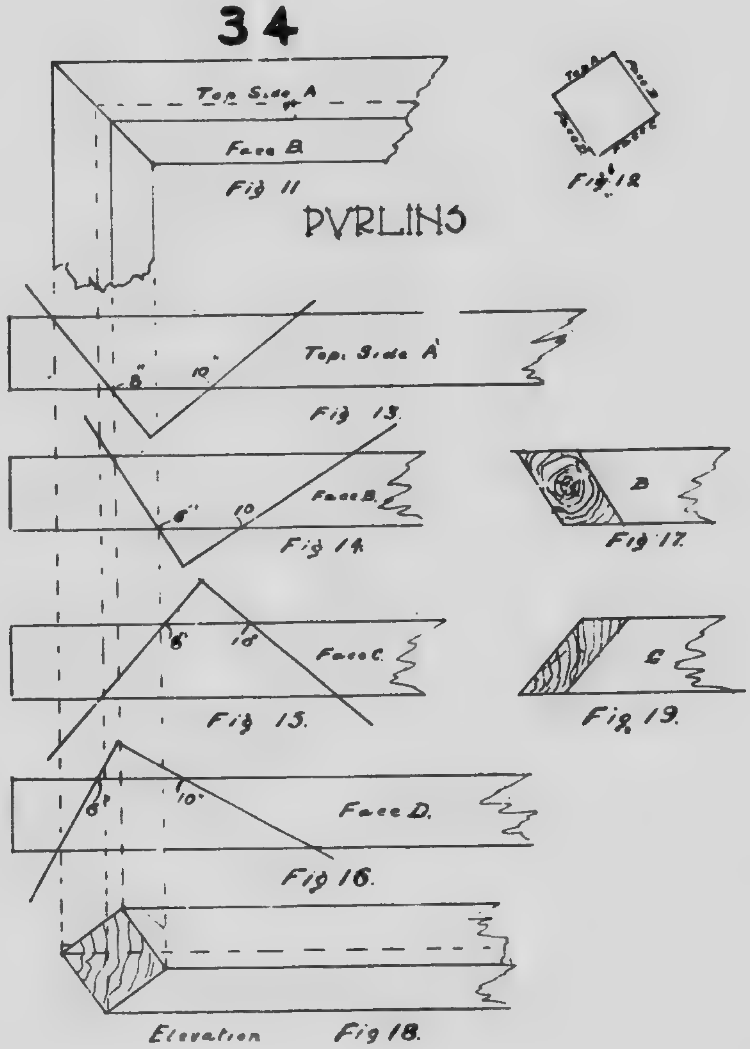


Fig 10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Top Side A
Face B.
Fig 11
PURLINS
Top A
Face B
Face C
Face D
Fig 12
Top. Side A
6"
10"
Fig 13.
Face B.
6"
10
Fig 14.
B
Fig 17.
6"
10"
Face C.
Fig 15.
C
Fig 19.
6"
10"
Face D.
Fig 16.
Elevation
Fig 18.

No. 23.

PURLINS.

Required, the figures to be used to mark the two sides, putting the ones to be marked on first.

Span.	Rise.	Figures to be used for the side that the rafters rest on.		Figs. to be used for the side facing the ridge.	
16′	6′	8″	10″	6″	10″
16′	7′	8″	10 5-8″	7″	10 5-8″
16′	8′	8″	11 5-16″	8″	11 5-16″
13′	6′	6 1-2″	8 10-12″	6″	8 10-12″
20′	9′	10″	13 7-16″	9″	13 7-16″
17′	7′	8 1-2″	11″	7″	11″

Answers.

HOPPERS.

Mitre Joint.

Lecture.

(1.) It is of little or no use to give a rule for doing a certain thing, or a formula for a certain operation, without giving the analysis, or explanation of the reasons why that formula brings the required results.

(2.) Now it will probably be plainly understood how the square was applied to the purlin, and by what means the lengths used were obtained.

(3.) Assuming that ground, let us proceed to the hopper problem. With Fig. 8 of the purlin problem as our Fig. 1, let us consider that we cut a board off at A., which we will assume already has the miter cut on it for the purlin.

(4.) Now let us state that we want a hopper of these dimensions.

4′ wide at the top.

8″ deep.

With a flair of 6″, and mitered at the corners.

(5.) Essentially this will require boards 10″ wide.

(6.) Now make use of the board that was cut off the purlin, and you will find that it has the correct miter for the hopper.

(7.) Therefore the figures to be used would be the same as they were for the purlin.

(8.) Now suppose that we had received this order for the hopper and had not first met with the purlin problem, how are we to find our figures on the square to use for the miter of the hopper?

(9.) Look at the plan of the hopper, Fig. 3, the 6″ flare shows from A. to B. so we know that a triangle of 6″ and 10″ lies in the corner at C.D.E. Therefore the square with 6″ and 10″ will mark this angle on the face of the board.

(10.) The other triangle for the cut on the edge of the board is not so easy to show, and there is nothing in this case so plain to be seen as there was when we got this cut for the purlin in the hip roof, which was the same as for the roof boards.

(11.) But to see where it lies look at the elevation drawn at C.F.G., Fig. 2, where the width of the board is taken square from the face of the hopper in the form of a rafter.

(12.) Then look at the plan C.G., Fig. 3, where a square is formed, 8″x8″ being the amount of the depth of the hopper.

(13.) Imagine a triangle on this corner which will be 10″x8″, F.C.J., where C.F. and H.F., Fig. 3 will be two rafters raised to the elevation of F.G., Fig. 2.

This triangle of the height of the hopper, 8″, and the width of the side of the hopper, 10″, will mark the miter as applied with the square.

(14.) Therefore now recognize that the depth of the hopper 8, C.K., Fig. 2, and the width of the side, 10″, C.D., will mark the miter cut on the edge of the board.

(15.) So to carry this on into further examples so as to form a rule independent of the purlin formula we will treat it in the three stages.

Statement.

Span.
Depth.
Flare.

Essentials.

Span.
Depth.
Flare.
Width of side.

Explanation.

(1) The one essential which we have to find is the width of the side.

(2) This can be found by measuring from the depth to the flare, or, as it may often happen that the width of the side is given instead of the height, and the height can be obtained by applying the rule to the square at the flare with the width of the side to find the depth. Fig. 4.

Formula.

(1.) Apply the square to the face of the board with the width of the board and the flare, mark on the flare.

(2.) Apply the square to the edge of the board with the depth of the hopper and the width of the side, mark on the side.

No. 24.

Examples.

Required: The width of the side and figures to be used for marking both angles.

Depth.	Flare.	Figs. to be used to mark the edge.	Side to mark on.	Figs. to be used to mark the face.	Side to mark on.
8"	6"	10"	8"	10"	6"
8"	7"	10 5-8"	8"	10 5-8"	7"
10"	9"	13 7-16"	10"	13 7-16"	9"

Answers.

35

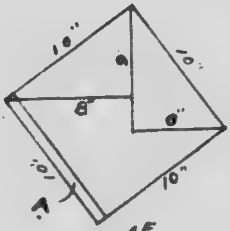


Fig 1.

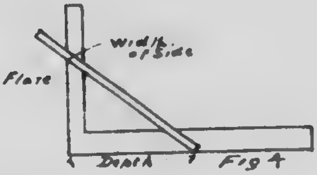


Fig 4

HOPPERS

mitre joint

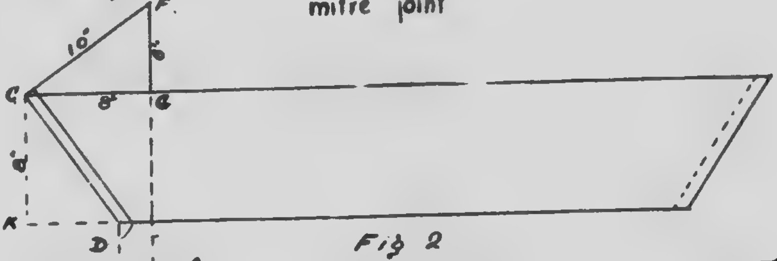


Fig 2

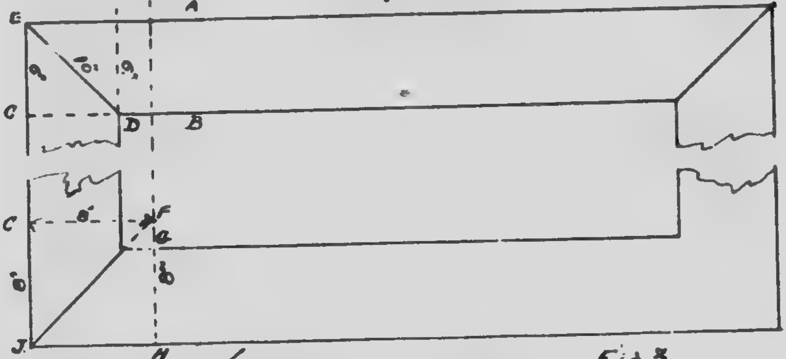
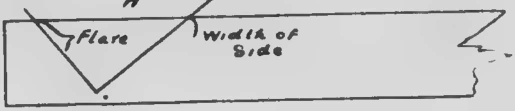


Fig 3.

1



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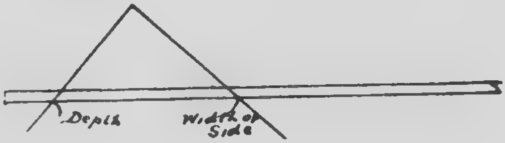


HOPPERS--BUTT JOINT.

Lecture.

(1.) In this example we will take a hopper 8" deep with a flare of 3". To find the width of the side of the hopper, measure from 8" to 3", which will be 8½". Fig. 5.

(2.) Looking down upon the triangle A.B.C., Fig. 2, we see a triangle 3"x3". But we know that from A. to B. when we take it down the slope of the side of the hopper is the width of the side of the hopper, 8 ½", therefore we have a triangle 8½"x3", so these will be the figures to use for the face cut for the hopper sides. Fig. 6.

(3.) To find the figures to be used for the butt cut is a matter of deeper consideration, and for this purpose let us look at the position of the triangle from which we obtain our lengths.

(4.) In Fig. 3 the square is placed with the depth and flare of the hopper 8" and 3" to mark the line A.B., which coincides with A.B., Figs. 1 and 2.

(5.) In Fig. 4 the square is placed along that line with 8½" at the side of the board; the other side will show 22 5-8".

(6.) Now we observe that this triangle in Fig. 4 is the same as B.A.D., Fig. 1 and that the line A.D., Fig. 1, which is in a plane with the edge of the hopper side and intersects with the base line at a distance of 22 5-8".

(7. Now turn to Fig. 2 and draw a line from B. in line with the inside bottom edge of the hopper proceeding to D.

(8.) Next draw a line from C. to E., Fig. 2 in line with the top edge of the hopper. It will be noticed that these lines are 3" apart and that the triangle D.A.C. (being taken in the plane A.D., Fig. 1) will be 3"x22 5-8".

(9.) The line C.D., Fig. 2 will be in a plane with the inside face of the hopper the same as C.B.

(10.) So whenever this is understood the rule becomes simple.

(11.) And now to reduce this theory to a short rule we will take it in the three stages.

(12.) By arithmentic all these lengths can be found by working the formulas given here.

To find the width of the side:—Extract the square root of the sum of the square of the rise and the square of the run.

3x8=8 ½"

To find the length of the line A.D., work the following proposition:—

3:8 = 8 ½ : A.D.

```
   85
    8
  ----
3)680(22.666—Ans. 22 5-8"
  6
  ---
   8
   6
  ---
   20
   18
   ---
    20
    18
    ---
     20
     ---
     18
```

Statement.

(1.) Depth 8".
(2.) Width across the top 2′ 6″.
(3.) Width across the bottom 2′.

Essentials.

(1.) The rise which is the depth 8".

(2.) The run or flare which is equal to half the difference between the width of the top and width of the bottom, 3".

(3.) The width of the side 8 1-2".

(4.) The length A.D., Figs. 4 and 1.

Explanation.

(1) To find the amount of the run subtract the lesser width from the greater, and divide the remainder by 2, thus 2′ 6"—2′ = 6".

(2) To find the width of the side, measure from run to rise, Fig. 5.

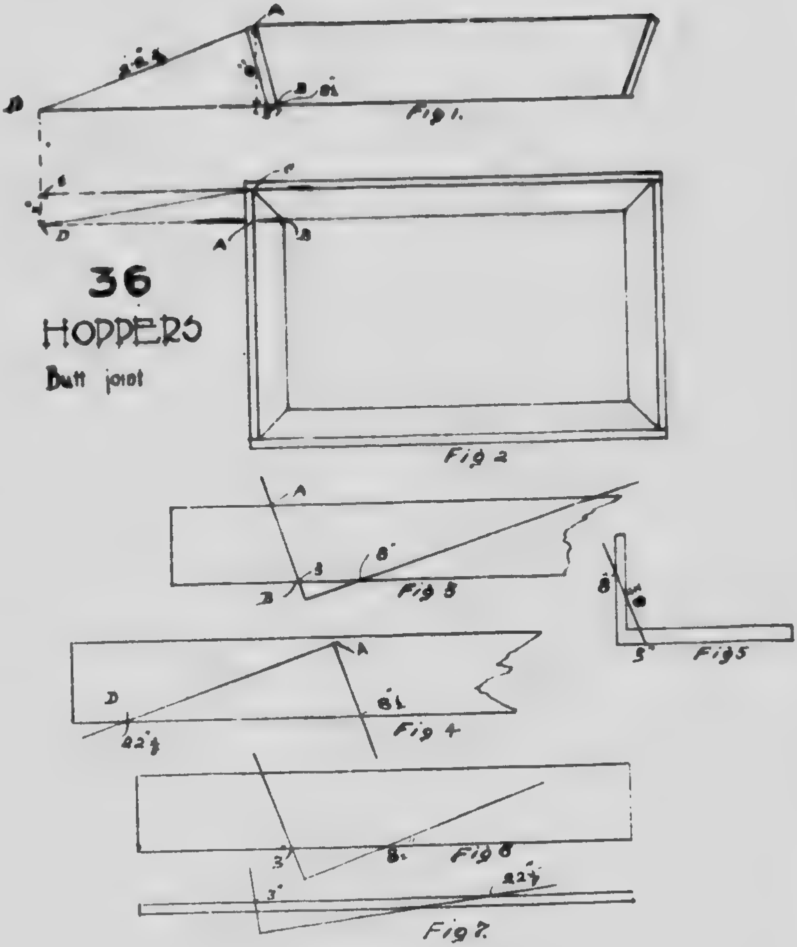
(3) To find the length of the line A.B., apply the square with the rise and run and mark the line B.A., Fig. 3.

(4) Then apply the square with 8 1-2" to the same line and the line A.D. will be 22 5-8".

Formula.

(1.) Apply the square with the flare and width of the side to mark the face cut.

(2.) Apply the square with the run 3" and the line A.D. to mark the butt joint.



No. 25.

HOPPERS.

Miter Joint.

Required: The width of the side and the figures to be used for marking of the cuts.

Depth.	Flare.	Width of Side.	Figures to be used for marking the face.		Figures to be used for marking the edge of board.	
8″	6″	10″	6″	10″	8″	10″
12″	5″	13″	5″	13″	12″	13″
14″	12″	18 7-16″	12″	18 7-16″	14″	18 7-16″

Answers.

No. 26.

BUTT JOINT.

Required: The angle for the face of the board and the angle for the butt joint.

Depth.	Flare.	Width of Side.	Figures to be used for marking the face.		Figures to be used for marking the edge of board.	
8"	3"	8 1-2"	3"	18 7-16"	12"	21 1-2"
8"	6"	10"	6"	10"	6"	13 5-16"
14"	12"	18 7-16"	12"	8 1-2"	3"	22 5-8"

Answers.

37

STAIRS

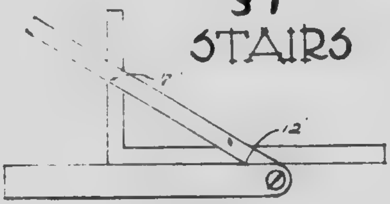


Fig 1.

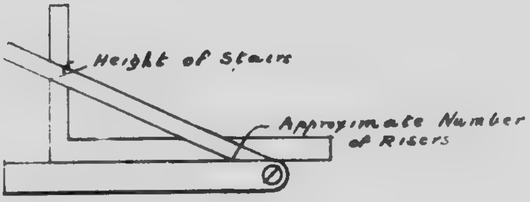


Fig 2.

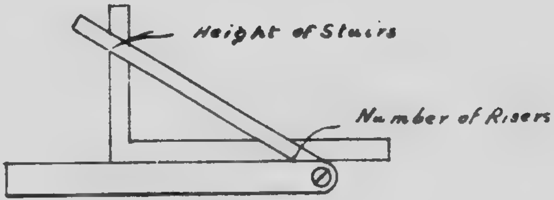
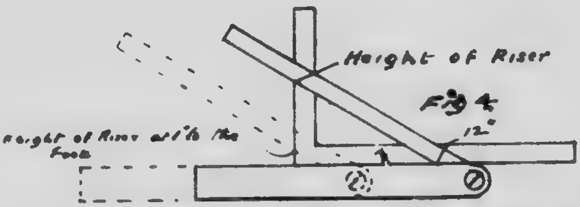


Fig 3.



Computing height of riser and width of go in stairs by means of steel square

What he is trying to [illegible] — this)
Take the rise $9\frac{1}{2}$ [illegible]
12" [illegible]

COMPUTING THE HEIGHT OF RISER AND WIDTH OF GO IN STAIRS BY MEANS OF THE STEEL SQUARE.

Lecture.

(1.) This is certainly an unusual style of problem, the very simplicity of it seems to rob it of any marked features by which to describe it.

(2.) It is a case of simple proportion and the one foot on the blade has nothing whatever to do with the run or tread of the stairs. It is merely a constant which we have adopted, as working so well with the scale of one inch to the foot.

(3.) There is nothing complicated about it at all once you grasp the effect of the change of scale.

(4.) As one foot is to seven inches, so one inch is to seven twelfths. In the first place we set the bevel at 12″ and 7″. This is no combination of rise and run and has nothing whatever to do with the run as yet.

(5.) Now imagine the square at 1″ and 7-12″, the bevel would be at the same angle, therefore the proportion would be the same.

(6.) We now wish to find out how many times this 7-12″ will go into the 9 1-2″ which represents the height of the stairs.

(7.) For this purpose slide the square to 2″, the tongue will show 14-12″ or two risers at the one inch to the foot scale.

(8.) Three inches will show 21-12″ and so on till we reach 16″ on the blade, and 9 4-12″ on the tongue, leaving a remainder of 2″.

(9.) We have proved by this process how the rule of division is worked by the steel square.

(10.) The next step will be to assume the position in which the proportion is perfect, which is that as 9′ 6″ is to 16 to the height of one riser is to 1′.

(11.) This gives us the opportunity to return to full size and place the bevel at 1′ on the blade.

(12.) The square will now read 1′ on the blade and the height of one riser on the tongue.

SPLAY CUTS FOR HIP AND VALLEY RAFTERS.

(By the Steel Square Method.)

Lecture.

(1.) It was mentioned in the lecture on hip rafters that the work of laying out hip rafters was in the three planes.

(2.) At that time only two planes were made use of, the third being left over till later in the course, and this we are now about to take up.

(3.) As was then stated, the first of the planes was horizontal at the level of plate involving the plates and the base line of the hip triangle.

(4.) The second plane is vertical and involves the hip triangle which consists of the base line (or run), the perpendicular (or rise), and the hip itself.

(5.) The third plane is in line with the back of the hip which we will proceed to locate.

(6.) For this purpose, in the plan Fig. 1, Plate 38, beginning at C. draw the line C.D. which cuts the plate A.B. at the centre, and proceeding to D. makes E.D. equal to C.E.

(7.) From the corner of the building at B. at right angles to the hip, draw the line B.D.

(8.) This will be at right angles to the run of the hip. As seen, these lines form a right angled triangle, the right angle being at B.

(9.) And not only is this line B.D. at right angles to the run of the hip as seen by the position of the square, but it is at right angles to the hip itself.

(10.) For this purpose suppose the end of the blade to be raised up till it lay on the back of the hip, it would then be in the third plane. This plane takes in the line B.D., the hip, and the line drawn from the point of the hip to the point D.

(11.) Now observe that the line D.C., Fig. 1, Plate 38 is in line with the ridge and therefore in line with the splay cut of the hip.

(12.) This is the acute angle of our triangle with sides the length of the run of the hip and the length of the hip.

(13.) Seeing where this triangle lies with the hip length B. to C. and the run length B. to D. and C.B. D., Fig. 1. Plate 38, this triangle is in the third plane.

(14.) So taking for example the roof with 16′ span and 6′ rise the hip run was 11′ 3 3-4″ and the length of the hip is 12′ 9 11-16″, so in Fig. 2 of the work movements those are the figures used, and the 12' 10" side gives the correct splay for an even pitched hip or valley rafter of this span and rise.

(15.) Assuming that the splay of the even pitched hip is understood and a clear conception of its third plane arrived at, we may now proceed to the hip in the roof where there are two different pitches.

(16.) As is generally the case when the plane is defined and the triangle located, the rest of the work is easy, and it is expected that by this time the student is familiar with the first two planes.

(17.) But as this work is taken in steps and it does not answer to take anything for granted, let us begin at the beginning with the problem in Fig. 2, Plate 38.

(18.) In this case the building has a span of 13' and the ridge comes within 8' of the end of the building and the rise is 6' 6".

(19.) To find the run of the hip, measure from 6' 6" to 8'. This gives the length from C. to B., Figs. 2 and 3, which length will be 10' 3 3-4" and 6' 6"rise; the length of the hip will be 12' 2 1-4".

(20.) This gives us the hip triangle from which the face of the hip can be laid out the same as in the previous cases. As will be remembered, each kind of rafter was laid out according to its triangle.

(21.) There remains, therefore, but one principal thing to be done with this rafter, that is to apply the splay cut, or it may be better to say splay cuts in case it may require the splay to be cut on both sides which will be determined according to the way the rafters are intended to fit together.

(22.) For the reason that the sides require different angles, we have to consider the whole plane of the hip which will be found to lie at the same pitch as the hip, in such a position that it exactly covers the triangle F.C.D., Fig. 2, Plate 38.

(23.) If a straight edge were applied to the back of the hip square across at the bottom end, it would be found to extend along the line from B. towards D. and from B. towards F., Fig. 2. Therefore we draw a line at right angles to the run of the hip, touching the corner of the building at B. Figs. 2 and 4.

(24.) The other boundaries of this plane are formed by the lines C.D. and C.F., Fig. 2.

(25.) To find the points D. and F. we begin with the point D., which is found by extending the ridge line indefinitely beyond the end of the building, and then at right angles to C.B., produce the line B.D.

(26.) Then to find the point F, begin at C. and at right angles to the ridge draw a line indefinitely beyond the plate. Then produce the line D.B. to F.

(27.) Now to conceive the idea of just the place and the extent of this plane, it must be understood that it is bounded by the horizontal line F.D. and the two elevated lines F.C. and D.C.

(28.) The line D.C. lies from the level of the plate at D. up to the point of the ridge at C.

(29.) The line F.C. lies from the level of the plate at F. to the point of the ridge at C.

The student should make sure that he understands just what is meant by the foregoing description of this plane, and how the lines apply for the splay cuts of the hip.

(30.) A stretchout view of this plane is shown in Fig. 4 in the triangle D.H.F. To show how this stretchout is drawn, upon the line B.C. erect a perpendicular line C.G. equal to the rise of the roof 6′6″

(31.) Join C. and B. which will be found to complete the hip triangle, with run C.B., rise C.G. and rafter length B.G.

(32.) Set the compasses at B. and G. and with this radius describe the arc G.H. This makes the line B.H. equal to the length of the hip rafter.

(33.) Join D. and H. by a line and likewise F. and H.

(34.) Now we have the plane of the hip laid down flat, enclosed by the lines F.D.D.H. and F.H., Fig. 4.

(35.) Now to consider a case where the four hips join in the centre as shown in Fig. 8, Plate 40.

(36.) First take the triangle H.B.F., Fig. 4, Plate 38, with sides 12′ and 12′ 8 1-2″, mark on the side 12′ 2 1-4″. Fig. 5, Plate 40.

(37.) Next take the triangle H.B.D. with sides 12 2 1-4″ and 8′ 4 1-2″, mark on the 12′ 2 1-4″, Fig. 6 which is according to the rule. Always mark on the hip length.

(38.) The rafter when cut will have an appearance as shown in Fig. 7, Plate 40.

(39.) A detail like this would occur in a case when the four hips meet in the centre as in detail Fig. 8. In this case the length would be taken on the side from the extreme point as shown in dotted lines at A., Fig. 7, Plate 40.

(40.) When only one cut is required as would be the case in Fig. 2, Plate 38, only one splay would be required as shown in Fig. 2, Plate 39. The length being taken on the long side and allowance made for the ridge.

(41.) There is still the most simple method of laying out these splays, which is the plan method which consists of marking a scantling with the horizontal measurements as in this case 6′ 6″ and 8′, as shown in Fig. 3, Plate 38. The amount marked K. is the amount to recede square from the plumb line for the long splay. The amount A. is the recession for the short splay.

(42.) One more application of the square should be considered before leaving the subject, and this is the method of finding the length of the lines B.D. and B.F.

(43.) By considering the Fig. 2, Plate 38. it will be seen that the triangles 1, 2, 3 and 4 are all similar that is, their angles are all alike. Each one contains angles of the same number of degrees, therefore, each one has sides bearing the same proportion to each other.

(44.) Therefore C.E. is to E.B. as C.B. is to B.D and E.B. is to E.C. as C.B. is to B.F.

(45.) Taking these in figures, 8′ is to 6′6″ as 10′ 3 3-4″ is to the amount we want to find (B. to D.)

(46.) 6′6″ is to 8′ as 10′ 3 3-4″ is to the amount we want to find (B. to F.)

(47.) For this purpose, apply the square to a board with Figs. 6 1-2″ and 8″, Fig. 9, Plate 40, mark on the 8″.

(48.) Slide the square as shown to 10′ 3 3-4″ on the blade. The other side will show the required 8 4 1-2″.

(49.) Secondly, slide the square till the 10′ 3 3-4′ comes to the edge of the board on the tongue, when the required 12′ 8 1-2″ will be indicated on the blade.

(50.) By these means any side of any of these triangles can be found without drawing a diagram or using figures.

(51.) N.B. The following shorter description of the process is that which has been used in giving instruction to the class, and may be looked upon as a set of rules or formulas to assist the student to remember the progressive steps of this practical work after the lecture has been read.

SPLAY CUTS BY THE DRAWING METHOD.

(1.) Extend the ridge line on the plan indefinitely beyond the end of the building C. to D., Fig. 2, Plate 38.

(2.) From the same point C. draw a line at right angles indefinitely beyond the side of the building C. to F.

(3.) From the corner of the building draw a line at right angles to the base of the hip, in both directions until it intersects with the two projected lines at F. and D.

(4.) Proceed as in the regular hip with the exception that these two triangles are used for the two splay cuts H.B.D. and H.B.F.

(5.) As half the great span is to half the small span, so the line C.F. is to C.D.

(6.) In all the triangles 1, 2, 3 and 4 their sides bear the same proportion to each other.

(7.) Mark a scantling with the square at 8′ and 6′ 6″. Fig. 3, Plate 38.

(8.) The space marked K., Fig. 3, is the amount to recede square from the plumb line for the long splay.

(9.) The space A., Fig. 3 is the amount to recede for the short splay.

Problem of Splay Cuts of Hips and Valleys by the Square.

EVEN PITCHED ROOFS.

Statement.

(1.) Span.
(2.) Rise.
(3.) Distance from the end of the ridge to the end of the building.

Essentials.

(1.) Rise.
(2.) Run of hip.
(3.) Length of hip.

Explanation.

(1) To obtain the run of the hip, measure from half span to half span.
(2) To obtain the length, measure from run to rise.

Formula.

(1.) Mark the point cut.

(2.) Mark the splay by applying the square with length and run of hip. The length will be the side to mark on.

(3.) Mark the plumb line on the other side.

(4.) Measure down the length.

(5.) Mark the seat cut.

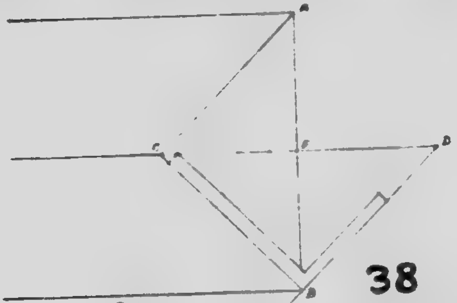


Fig 1

38

BEVEL CUTS FOR HIPS AND VALLEYS

Steel square method

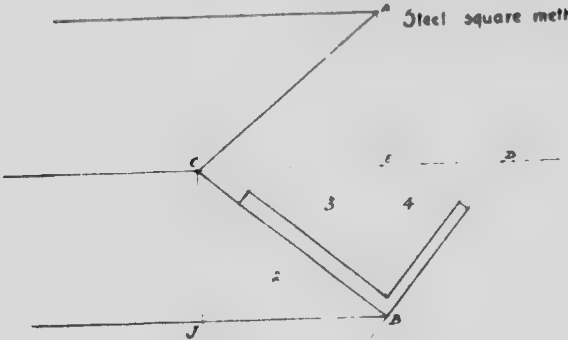


Fig 2

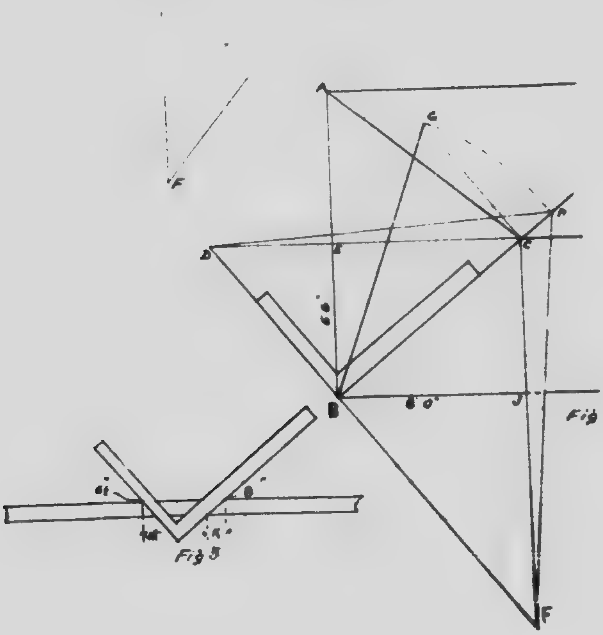
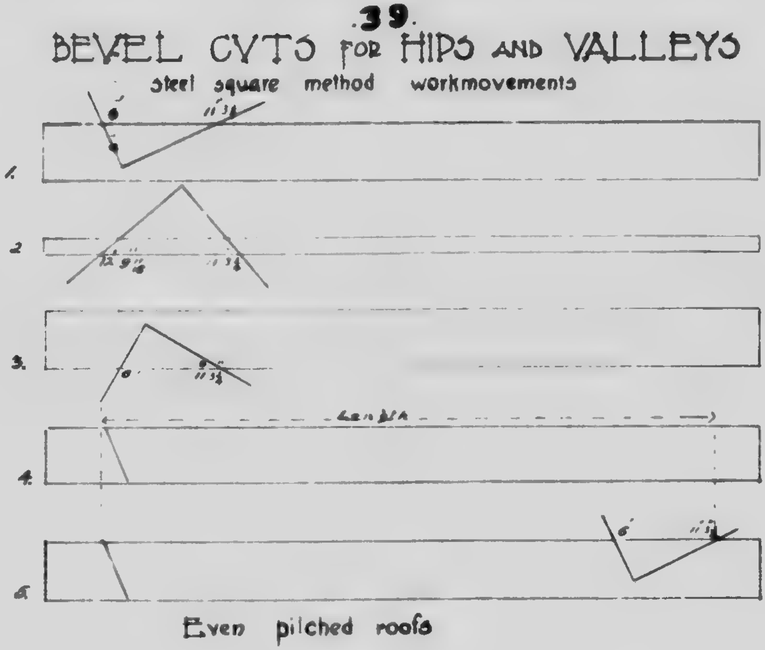


Fig 4

Fig 3


39.
BEVEL CUTS FOR HIPS AND VALLEYS
steel square method workmovements
1.
2
3.
4.
5
11 3/4
12
9 1/4
Length
6
Even pitched roofs

SPLAY CUTS OF HIPS AND VALLEYS BY THE SQUARE.

UNEQUAL PITCHED ROOFS.

Statement.

(1.) Span.
(2.) Distance of ridge from end of building.
(3.) Rise over all.

Essentials.

(1.) Greater run.
(2.) Lesser run.
(3.) Rise.
(4.) Run of hip.
(5.) Length of hip.
(6.) Lengths to be used for marking splays. F.B. with length of hip for short splay, also for the long splay the length of the hip and B.D., Fig. 2, Plate 38.

Formula.

(Work movements, Plate 40.)

(1.) Mark the point cut.
(2.) Mark the splay.
(3.) Mark the plumb line on the other side.
(4.) Measure down the length.
(5.) Mark the seat line.

Explanation.

(1) To obtain the run of the hip, measure from greater run to lesser run, 8′ to 6′6″.

(2) To obtain the length, measure from run to rise, 10′ 3 3-4″ to 6′6″.

(3) In even pitched work the length and run could be used for all splays, but in unequal pitched work there is the long splay and the short splay.

(4) In both cases the length of hip is one of the lengths used, and in both cases it is the length to be marked on.

(5) The other lengths to be used are shown in Fig. 2, Plate 38, which are, B. to F. and B. to D.

(6) First for the long splay, the length of the hip, and the length B. to D.

(7) Second, for the short splay, the length of the hip and the length B. to F.

(8) To find these lengths B.D. and B.F. only requires the application of simple proportion and can be done either with the square or with figures

(9) By arithmetic the formula is as follows for the two cases. As B.E. is to E.C. so B.D. is to C.B. and as B.D. is to C.B. so C.B. is to B.F.

(10) Now it can be seen that the triangles 1, 2, 3 and 4 and all adjacent triangles are in the same proportion, so that the length of any side can be found by the square if the length of the adjacent side be known.

(11) So for this purpose follow the moves in Fig. 9, Plate 40.

(12) As the 1st, 2nd and 3rd positions are plainly shown, it will be seen how these lengths are obtained by advancing on the numbers we know to find out the unknown.

(13) In the case shown in Fig. 2, Plate 40, the long splay is used. For the short splay the greater length B.F. is used with the length of the hip.

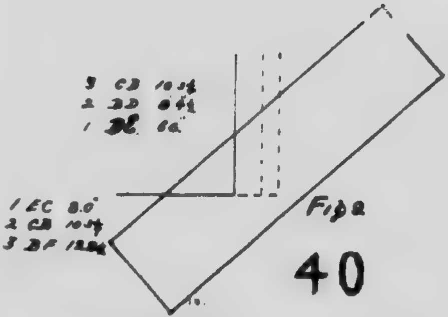


Fig 2

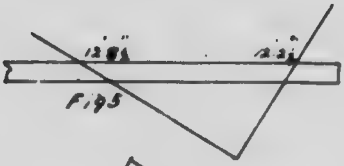


Fig 5

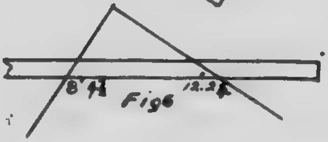


Fig 6

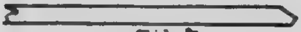


Fig 7.

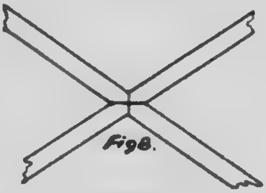
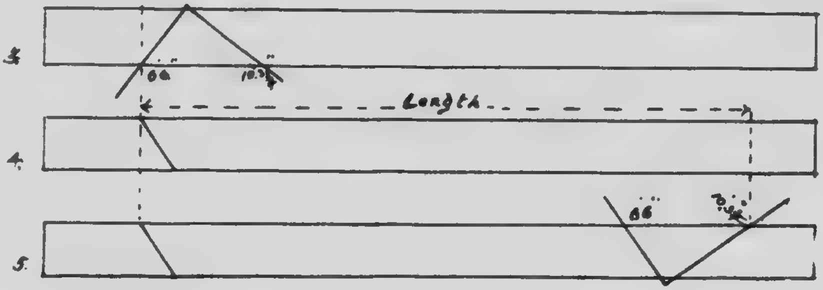


Fig 8.

40

BEVEL CUTS FOR UNEQUAL HIPS & VALLEYS

workmovements



No. 26.

SPLAY CUTS. HIPS AND VALLEYS.

Required: The lengths to be used to mark the splays, long and short, the length to be marked on being put last.

Great Run.	Lesser Run.	Rise.	Run of Hip.
8′	4′	6′	8′ 11 3-8″
11′	10′	9′	14′ 10 3-8″
9′	6′6″	7′	11′ 1 1-4″

Answers

Long Splay.		Short Splay.	
Base line.	Hip.	Base line.	Hip.
4′ 5 3-4″	10′ 9 1-4″	17′ 10 3-4″	10′ 9 1-4
13′ 6 1-8″	17′ 4 1-2″	16′ 4 1-4″	17′ 4 1-2″
8′ 1-4″	13′ 6 1-2″	15′ 4 1-2″	13′ 6 1-2″

Answers.

THE TOP OF THE SHORT VALLEY.

IRREGULAR PITCHED ROOFS.

Lecture.

(1.) There is no right angled triangle which applies to the surface of this rafter, but this process will get the cut, though it will require much careful work to make it accurate.

(2.) Apply the plumb line and mark it on both sides as for a square cut.

(3.) Recede the amount for a main roof jack from B. to D. and join the lines at the top of the splay, C. to D.

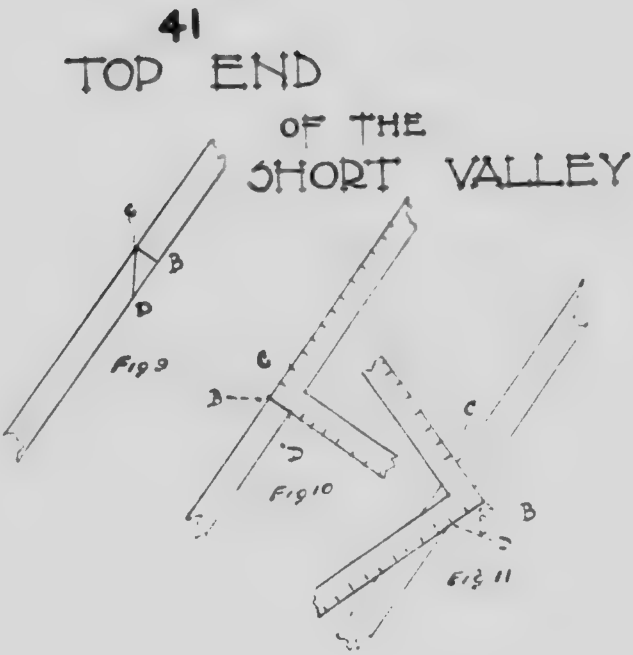
(4.) (Note that this line would be right in line with the ridge of the pediment so that the two valleys if cut at the splay would fit at that point).

(5.) This line is shown in Fig. 9 from C. to D.

(6.) In Fig. 10 the square is laid on the scantling for the purpose of finding the amounts B.D. and C.B.

(7.) Then turn the square over into position in Fig. 11 with the same figures at D. and C. and draw the line down from C. for the splay cut marked E., Fig. 5, Plate 16.

(8.) Before leaving the subject let us drive home one fact, and let it never be misunderstood. The receding in all these cases is horizontal, and that it is applied on the level, strictly square from the plumb line, so that if we say recede 1 1-4″ that means that we draw another plumb line 1¼″ from the original plumb line as at point E., Fig. 5, Plate 16.



No. 28.

TOP OF SHORT VALLEY.

Required: The figures to be used on the short valley, to be reversed over to mark the splay, the one to be marked on being put last. 2" material is used.

Main Rise.	Main Run.	Intersecting Building Rise.	Intersecting Building Run.	Ridge.	Half lesser span.	Figures to be used for obtaining amount to recede	Figures used on top edge of short valley.
						Answers.	
10′	30′	8′	6′	8′	6′	2″	3 3-8″
9′	12′	6′	5′	4′6″	5′	2″	2 7-16″
9′	10′	8′	9′	7′2 3-8′	9′	2″	2 1-16″

Short Valley.

Run.	Length.
10′	12′ 9 5-8″
6′ 8 3-4″	9′ 1-8″
11′ 6 5-16″	14′ 3-8″

BACKING OF HIPS.

Lecture.

(1.) As this is a mere detail in roof construction which is not in general practice, it has not been considered necessary to embody it in the course but rather treat it as an isolated problem.

(2.) For the purpose of simplicity, let us go back to our old friend the even pitched hip roof and show it in plan Fig. 1, which for convenience is set cornerwise.

(3.) Now observe that the section of the hip shown in Fig. 2 is backed according to the transverse pair of hips.

(4.) Fig. 3 shows a section of the hip full size with the lines for the backing at the same angle as the hip in Fig. 2.

(5.) Now turn to Fig. 4 and see how the backing line has been developed from the section Fig. 3, which shows that we have obtained the amount to descend upon the plumb line.

(6.) The amount a,b, Fig. 2 will be exactly the same as a,b, Fig. 3, so that the amount to descend for the backing can readily be obtained from a drawing like Fig. 2 without Figs. 3 and 4.

(7.) The foregoing, it is hoped, will assist in making clear the steel square method in Figs. 5, 6, 7 and 8.

(8.) In Fig. 5 the square is placed with the rise and run of the hip to the edge of a scantling and mark on the rise 6′.

(9.) The important point to understand is that the angle shown at 6, Fig. 5 is the same as the angles shown in Fig. 3 and the pitch of the hips in Fig. 2.

(10.) Now cross this line with another at the same pitch, Fig. 6.

Fig. 7 shows the two lines crossed.

Fig. 8 shows the lower half of this cross which will be the same as Fig. 3, and in the same way showing the amount to descend on the plumb line to mark the backing line.

The three stages will be taken up as follows.

Statement.

(1.) Run of hip
(2.) Rise of hi

Essentials.

(1.) Run of hip.

(2.) Rise of hip.

(3.) Amount to descend on the plumb line for the backing.

Formula.

(1.) Apply the square with the run and rise of hip. Fig. 5.

(2.) Apply the square with the run and rise of hip crossing the first line in the centre. Fig. 6.

(3.) Mark a line square across this centre which will show the amount to descend. Fig.8.

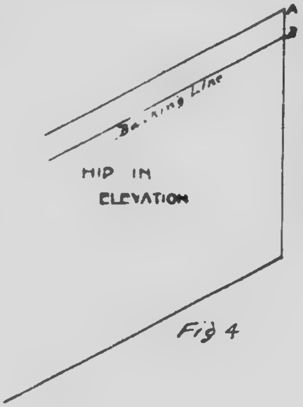


Fig 4

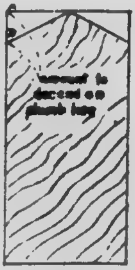
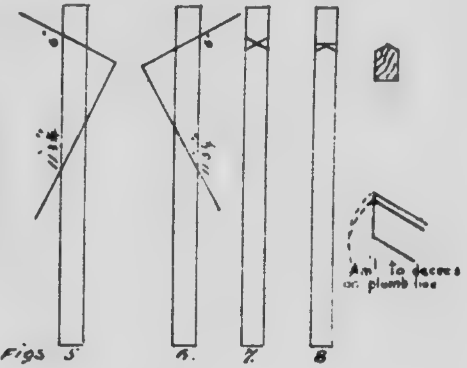


Fig 3



Figs 5 6. 7. 8

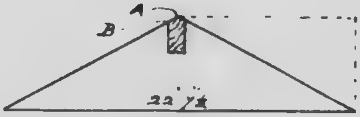


Fig 2

BACKING OF HIPS

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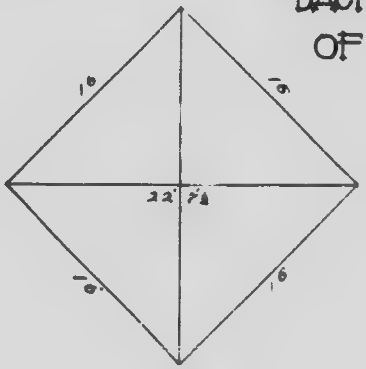

Fig 1.

No. 29.

Backing of Hips.

Required: The amount to descend upon the plumb line for the place to mark the line for the backing.

Span.	Rise.	Perpendicular depth of backing.
16′	6′	17-32″
16′	7′	5-8″
16′	8′	11-16″
13′	6′	5-8″
20′	9′	5-8″
17′	7′	7-12″

Answers.

THE PLAN METHOD FOR PEDIMENT SPLAY CUTS.

Lecture.

(1.) There is a connection between the jacks in the main roof and the jacks in the pediment which it will be well to understand.

(2.) Its usefulness is very far reaching as it is one of these features of the work which to master seems to enlarge a man's comprehension of trade problems.

(3.) Taking the plan method to find the splay cut of the pediment jacks simply requires that we consider the angle as aplied to a joist lying perpendicular under the rafters we are considering, as seen in plan Fig. 5, Plate 16 where the lines may be looked upon as representing either joists or rafters.

(4.) To mark this angle apply the square to the scantling with the half span of the pediment on the tongue and the length of the ridge on the blade as seen in Fig. 4 1-2, Plate 17.

(5.) The angle marked by the tongue shows the amount to recede for pediment jacks.

(6.) The amount marked by the blade shows the amount to recede for the main roof jacks.

(7.) This rule holds good in all cases where one roof enters the other at right angles.

(8.) The proof of the rule being that the rafters of the pediment are at right angles to the rafters of the main roof.

(9.) The valley always intersects this right angle, and no matter what skew the valley has, the angles on both sides of it added together always make a right angle.

(10.) When the pitch is unequal, one angle is greater and one less than 45 degrees.

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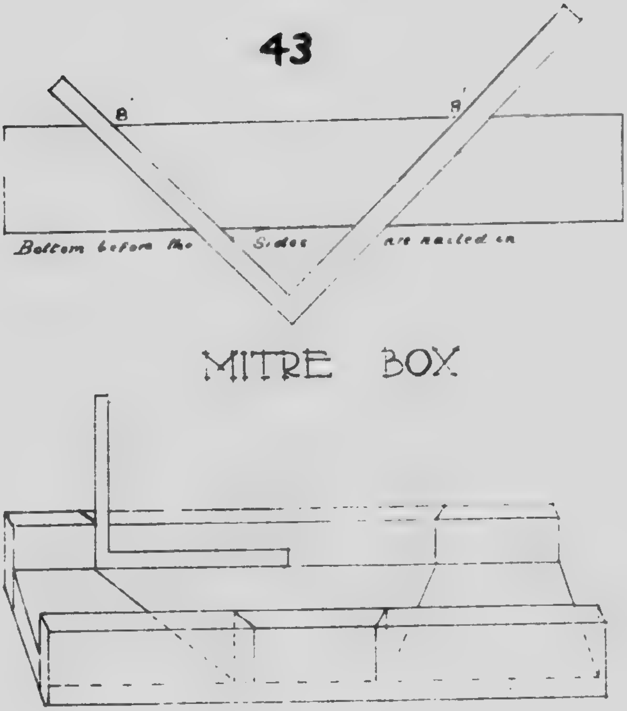


MITRE BOX.

Lecture.

(1.) We may hardly pass by and say the subject is complete without showing how the cut is obtained for a miter box.

(2.) Therefore it will be well to pass through the movements in which the square is engaged.

(3.) To begin with, the bottom of the box is made true, the edges square, straight, and parallel one with the other.

(4.) Then the square is applied to the side which is going to be the uppermost in the box, with two numbers that are alike, such as 12 and 12 or 8 and 8, as the case will stand, then nail the sides on, and sliding the square inside the box, mark the lines up the sides, then mark them on the top and the box is ready for sawing.

ROOF BOARDS.

Lecture.

(1.) The question of the roof boards has not been taken up with each problem for the reason that it would be an encumbrance and would always be in the way of that which is of the first importance, and as it can be said to require but one rule, it would be needless and a loss of energy to bring it in with every rafter problem.

(2.) All that is necessary is to realize that there is a triangle to be covered with boards.

(3.) That same triangle had to be filled with jacks.

(4.) The same lengths on the square that were used to mark the splay on the jacks will answer for the roof boards.

(5.) The only difference is that you mark on the other side of the square.

COLLAR TIES.

(1.) Seeing that the question of the length of collar ties is liable to come up at any time, though generally quite as a minor question, it will be well to give a rule for it, or at least to draw attention to the way the problem is worked.

(2.) For this purpose we will refer back to the exercises for finding the length of the ridge of the intersecting building.

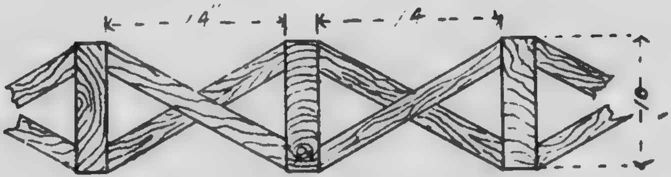
(3.) Just reverse the rule. By this we mean, assume that the bottom of the collar tie takes the place of the ridge of the intersecting building as regards height.

Rule.

(1.) Place the square on a board with the main rise and run and mark both lines.

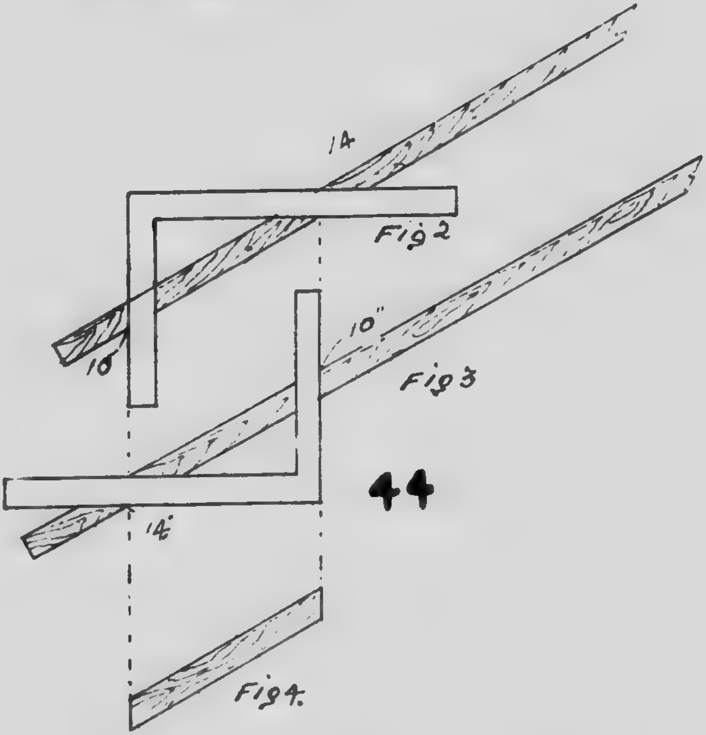
(2.) Slide back to the height of the collar tie.

(3.) The distance from this to the main rise line will be half the length of the collar tie.



Fig

BRIDGING



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LAYING OUT BRIDGING BY MEANS OF THE STEEL SQUARE.

Statement.

(1.) Depth of joists.
(2.) Distance between joists.

Essentials.

(1.) Depth of joists.
(2.) Distance between joists.

Formula.

(1.) Place the square with the amount of space at the top of the scantling and depth of joists at the bottom. Fig. 2 and mark on the depth side.

(2.) Reverse the square upside down with the depth where the width was and the width where the depth was, again mark the depth side, Fig. 3. Observe the bridging, Fig. 4 as developed from Figs. 2 and 3.

SUM TOTAL, OR ANALYSIS OF THE STEEL SQUARE MYSTERY.

It is generally the case that great questions have very simple answers, and that great problems can be very simply solved.

With this in view, let us enumerate the actual operations which can be performed with the steel square.

In the hands of an expert the square performs the following three principal functions.

(1.) Marking angles.
(2.) Finding lengths.
(3.) Ascertaining proportions.

Granted it has many minor uses such as striking circles, ellipses, etc., being used as a straight edge, measuring rule, and many other things which can be easily done with something else, but the realm in which the steel square reigns supreme is in these three functions.

In the hands of the master craftsman this instrument and this system are without equal, and there is very little indeed in this system beside the exercise of these three functions and the use of the common rule and figures.

For an example of the first of these just notice that it is the first used for marking right angles, then observe how it is used for all the angles in roof construction.

For the second see how all the lengths of common hip and valley rafters are found.

The third is not so universal, but is used in finding the length of the short valley, or the diminishing length of jacks.

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CONDENSED
RULES
FOR ROO.
FRAMING

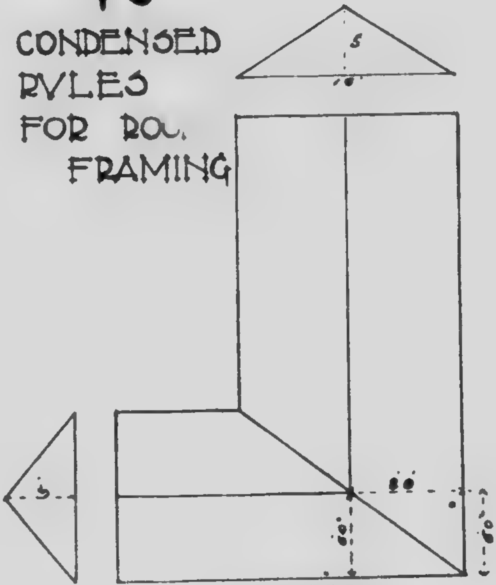


Fig 1.

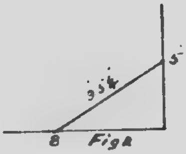


Fig 2

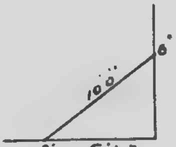


Fig 3.

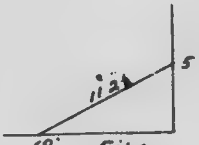


Fig 4.

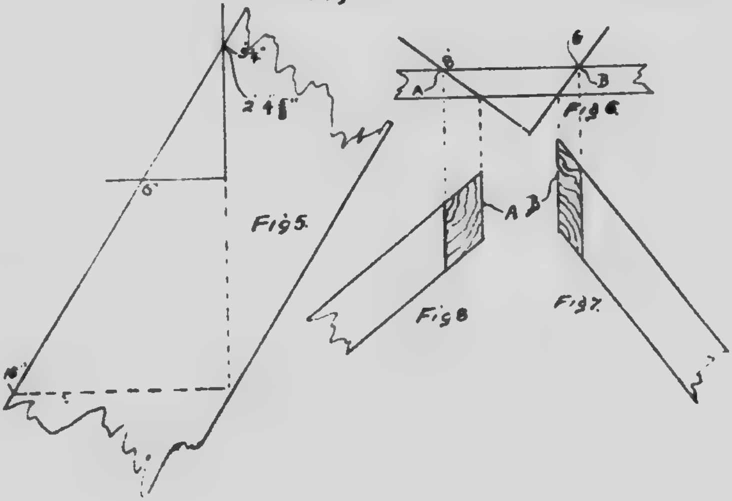


Fig 5.

Fig 6.

Fig 8

Fig 7.

CONDENSED RULES FOR ROOF FRAMING.

(1.) To find the length of any common rafter, hip, or valley. Measure from run to rise, see Fig. 2, length 9′ 5 1-2″.

(2.) The run of a rafter is a horizontal line lying from a point directly below the point of the rafter to the heel.

With the common rafter this is half the span of the building.

With the hip or valley the length of the run is obtained by measuring the square from side run to end run as shown in Fig. 3, from 6″ to 8″ which equals 10′.

(3.) For the length of the hip or valley measure from run to rise, in this case 10′ to 5′. See Fig. 4, result 11′ 2 1-8″.

(4.) For the diminishing length of the jacks, apply the square to a board with the length of the first common rafter to the corner of the building, in this case 9′ 5 1-4″ to 6′; then slide down to the amount of the spacing on the tongue of the square. The diminishing length will then be shown on the blade at the edge of the board. Fig. 5.

This rule for the diminishing of jacks will apply to the hip and valley jacks as well as to all pediments and in all cases where the lengths of the two sides of the triangle are known.

(5.) The splay cuts are obtained in this way.
Apply the square to the edge of a scantling with the side and end runs. See Fig. 6.

The amount marked A., Fig. 6 will be the amount to recede square from the plumb line for the long splay, the amount B. will be correct for the short splay in hips, valleys or jacks.

(6.) (Note) In even pitched work the square may be applied to the top of the rafter with the length of the common rafter and its run and mark on the length for the splay jacks.

(7.) For the splay of hip or valley use their run and length marking on the length.

PAPERS COVERING WHOLE PROBLEMS.

The exercise sheets throughout the course have been intended for class work. And as it has been found that a whole problem is often too much for a lesson, so the problems have been divided into parts so that they can be covered in an evening's work.

In the following the exercises have been brought together in a form in which each problem is treated and its measurements stated in consecutive order.

EVEN PITCHED HIP ROOFS.

Figures to be used for laying out the splay.

The amount to reced for the splay will be the thickness of the rafter square from the plumb cut.

Span.	Rise.	Run of Hip.	Length of Hip.
16′	6′	11′ 4″	12′ 10″
16′	7′	11′ 4″	13′ 3 5/8″
16′	8′	11′ 4″	13′ 10 1-4″
13′	6′	9′ 2 1-4″	10′ 11 9-16″
20′	9′	14′ 1 5-8″	16′ 9 1-8″
17′	7′	·12′ 1-4″	13′ 9 15-16″
23′	11′	16′ 3 1-8″	19′ 7 9-16″
19′	6′ 6″	13′ 5 1-4″	14′ 11-16″
7′	3′ 2″	4′ 11 3-8″	5′ 10 1-2″
32′	12′ 8″	22′ 7 1-2″	25′ 11 1-8″
40′	14′ 6″	28′ 3 3-8″	31′ 9 3-8″

EVEN PITCHED VALLEY ROOFS.

Main Span.	16′	16′	16′	13′	20′	17′	23′	19′
Main Rise.	6′	7′	8′	6′	9′	7′	11′	6′6″
Lesser Rise.	4′ 6″	4′9 13-16″	4′6″	3′8 1-4″	4′11 7-16″	2′5 5-8″	9′6 7-8″	4′9 3-8″
Lesser Span.	12′	11′	9′	8′	11′	6′	20′	14′
Run of Long Valley.	11′4″	11′4″	11′4″	9′2 1-4″	14′1 5-8″	12′ 1-4″	16′3″	13′5″
Length of Long Valley	12′10″	13′3 5-8″	13′10 5-8″	10′11 1-2″	16′9 1-8″	13′9 1-4″	19′7 1-4″	14′10 13-16″
Length of Short Valley	9′7 1-2″	9′1 1-8″	7′9 5-8″	6′8 1-8″	9′2″	4′10 1-2″	17′4-12″	10′11 3-12″

The amount to recede for the splay cut will be the thickness of the rafter square from the plumb cut.

UNEQUAL PITCHED VALLEYS.

Main Span.	30′	18′
Main Rise.	15′	12′
Lesser Span.	12′	10′
Lesser Rise.	8′	6′
Length of the ridge of the intersecting building	8′	4′6″
Run of Short Valley	10′	6′8 3-4″
Length of Short Valley.	12′9 5-8″	9′1-8″
Length of the Long Valley.	24′ 1-8″	18′ 5-16″
Figures to be used for plumb cut.	8′	6′
Figures to be used for seat cut.	10′	6′8 3-4″

IRREGULAR HIP ROOFS WITHOUT PROJECTION

Required: Run of hip. Length of hip. Amount to recede square from the plumb line for both long and short splays.

Span.	Rise.	Distance of ridge from end of building.	Run of hip
16′	6′	4′	8′11 5-16″
16′	7′	5′	9′5 1-8″
16′	8′	6′	10′
13′	6′	7′	9′6 5-8″
20′	9′	11′	14′10 3-4″
17′	7′	9′	12′4 9-16″
23′	11′	9′	14′7 1-4″
19′	6′6″	7′	11′9 5-8″
7′	3′2″	15′	15′4 13-16″
32′	12′8″	10′	18′10 7-16″
40′	14′6″	16′	25′7 3-8″

Length of hip.	Amount to recede, Long Splay.	Short Splay.
10′9 1-4″	4″	1″
11′9″	3 1-4″	1 1-4″
12′9 11-16″	2 8-12″	1 1-2″
11′3 3-8″	2 1-8″	1 7-8″
17′4 1-2″	2 1-4″	1 3-4″
14′2 5-8″	2 1-8″	1 7-8″
18′3 3-8″	2 9-16″	1 9-16″
13′5 5-8″	2 3-4″	1 1-2″
15′8 11-16″	8 1-2″	1-2″
22′8 11-16″	3 3-16″	1 1-4″
29′5 3-16″	2 1-2″	1 5-8″

UNEQUAL PITCHED HIP ROOF WITH EVEN CORNICE.

Span.	16′	20′
Rise.	6′	9′
Distance of ridge. from end of building.	4′	11′
Difference in height of plates.	9″	1 7-16″
Distance from the end of the upper plate to the projection of the common rafter.	2′	1′ 7 13-16″
Amount that the hip recedes from the corner of the building.	1′	1 13-16″
Rise per width of cornice on the steep side.	1′6″	1′4″
Projection of hip.	2′2 7-8″	2′ 2 3-4″
Amount to recede for short splay.	1″	1 13-16″
Amount to recede for long splay.	4″	2 3-16″
Run of hip.	8′11 3-8″	14′10 3-8″
Length of hip.	13′1 1-2″	17′4 1-2″

Glossary of Words and Phases Used in this Book.

Abbreviated.
Cut short, shortened.

Accordance.
Agreeing to, or in agreement with.

Acute Angle.
An angle less than 90 degrees or sharper than a square corner.

Adjacent.
Touching or near to.

Adjoining.
Touching or joined to.

Anchor Bolts.
Bolts built in, upon which to fasten subsequent work.

Arithmentical.
Pertaining to arithmetic.

Ascertained.
Found out, made certain.

Assemble.
To bring together.

Assume.
To take or accept certain positions or certain conditions and use them.

Backing of hip.
That part which is taken off to make a flat surface for the roof boards to rest on.

Base Line.
The horizontal line of a triangle, main or central line from which to measure.

Barge Board.
The facia of a gable enlarged or enriched by mouldings, panelling or scroll work.

Baluster.
Vertical pieces attached to the lower side of the hand rail.

Bedmould.
A moulding which fits into an angle such as against the wall under the eaves, or round the ceiling against the wall.

Bevel.
An angle, or the surface where a corner has been cut off or removed.

Bird's Mouth.
The triangular cut in a rafter which receives the plate.

Brace Measure.
A rule for finding the length of braces.

Butt Joint.
A joint where the end of one piece fits against another piece.

Camber.
The curved part of a window, door or opening.

Carriages.
Those pieces which support the stairs from below.

Centre of an arch.
The curved shape which supports an arch during construction.

Cipher.
The figure 0.

Coincide.
To agree or be in harmony with.

Collar Tie.
A horizontal timber holding a pair of rafters together such as will be found carrying the ceiling of an attic.

Common rafters.
Those used in plain gable roofs or in any roof where a number are used of the same length and pattern.

Complicated.
Containing may variations, difficult to understand or manipulate.

Compute.
To calculate or reckon.

Conceive.
To originate; to form an idea.

Concrete number.
One applied to a particular object as opposed to abstract number, 7, 17, 35 are abstract, while 7 ft., 17 inches, 35 yards are concrete numbers.

Conjunction.
Conjoined.

Construct.
To build and attach together

Constructiveness.
The ability to design and build.

Cornice.
The eaves of a building or the angle formed by wall and roof.

Consecutive.
One after another recurring regularly.

Crown Mould.
The mould at the top edge of a cornice.

Cuts of Rafters.
Those angled surfaces which make the scantling into a rafter.

Data.
Information on which to work.

Decimals.
A rule in arithmetic in which numbers are worked in tenths, hundredths, thousandths, etc.

Deficiency.
Lack, inability, inequality.

Degrees (45
The angle for a square miter; the eighth part of a circle (see the miter box, Sec. 10).

Denominator.
The lower number in a fraction as 8 in the fraction

Designate.
To distinguish by a certain number or term.

Detail.
A small part; a term often applied to a drawing or some minor but important part of a structure.

Detached.
Standing alone, separate from.

Development.
Growth, or increase, in technical drawing. The drawing is developed from the draftsman's conception of an article to be shown, and each view of the article is drawn or developed so as to harmonize with the rest.

Diagonal.
A line from one corner to the opposite corner of a figure of four or more sides.

Diagram.
A linear drawing of a descriptive nature.

Dimension.
Measurement in different directions as length, breadth and thickness.

Diminish.
To make or become less.

Diminishing length of jacks.
The amount that one jack differs in length from the one next to it.

Diminished.
Made less or lessened.

Dispensed.
Distributed or disposed of.

Dividend.
A number or quantity which is to be divided.

Division.
The act of dividing, and the arithmetic rule by which it is performed.

Dovetail.
A form of joint.

Dormer.
A window in a roof, distinguished from the gothic or pediment by having eaves at its sides as a separate building inserted in the roof.

Drawbore.
A term used in mortise and tennon work where a hole is bevelled for a peg in such a way that as the peg (being pointed) is driven in, it draws the shoulder up tight.

Elevation.
A drawing showing one side of a building.

Equal Pitched.
Having the same pitch in its different parts.

Essential.
Necessary, (in this book essential is a name given to one stage of the steel square work.)

Evaded.
Avoided.

Even pitch.
Same as equal pitch.

Face.
That part of the work to which all the rest must conform and agree.

Facia.
The outside board of the cornice.

Filler.
The pieces of wood which are laid in the groove between the balusters.

Flare.
In hoppers means the lean which the side has.

Formula.
In chemistry a list of ingredients to form a certain mixture. In technical subjects a rule for performing a certain piece of work.

Fraction.

A vulgar fraction understood to apply to such expresions as 7-8, 3-4, 5-16, 1-2, etc.

Framer.

One engaged in constructional woodwork.

Frieze Board.

A board along the wall underneath the eaves.

Frog.

Technically an internal angle to which another piece is fitted, as the valley rafter is fitted to the intersection of the plates.

Front rafter.

The end rafter in a gable roof or the longest rafter in a pediment.

Gable.

The vertical triangle formed by the rafters in the end of a roof.

Gable roof.

A pitched roof that is not hipped at the ends.

Go.

In stairs, the distance from face of riser to face of riser.

Graduations.

On the square, those marks which indicate inches, halves, quarters, eighths, etc.

Great Rise.

In intersecting roofs, the higher roof contains the great rise, and the lower roof the lesser rise from the plate level.

Header.

A cross piece between other timbers, generally used in trimming for chimney breasts, well-holes and other openings.

Heel of rafter.

The lower end which sets on the plate.

Hip rafter.

The rafter forming the external angle in a roof.

Homogeneous.

Of the same kind.

Horizontal.

In line with the horizon, level. Forming a right angle with the vertical.

Housing.

In stairs, the grooves into which the treads and risers are fitted.

Hypothenuse.

The longest side of a righ tangled triangle, the side opposite the right angle.

Illustrate.
To show by visible signs as in pictures or drawings.

Indicated.
Shown or pointed out.

Indispensable.
Absolutely necessary.

Intersection.
The meeting place or crossing of two lines.

Intersected.
Divided.

Involve.
To connect, to include to complicate.

Irregular Valley.
One which forms the intersection between roofs of different pitches.

Isolated.
Standing alone or separated from.

Jack Rafters.
Those rafters of varying lengths which attach to hips and valleys to fill in the irregular spaces of the roof.

Jack Triangle.
The three cornered space in which the jacks are placed to support the roof boards.

Joists.
Timbers which support the floor.

Juncture.
A joining, a specified point of time.

Layout.
To put the lines upon the work which are to be followed in sawing, framing and erecting.

Lesser rise.
Where two buildings intersect with a level plate the lower roof has the lesser rise.

Main Roof Jacks.
Those in a plane with the common rafters in the larger or principal roof.

Main roof.
The larger or principal roof to which adjoining roofs must conform.

Mathematics.
The science of arithmetic, algebra, geometry and mensuration.

Member.
A continuous piece of work is said to be composed of certain members, as in cornice, the facia, soffit, crown mould, bed mould, etc.

Mitre.
The angle of intersection of two places of wooden or other material.

Minus.
In arithmetic means less, the minus sign means that the number after is to be taken from the one before the sign, as 5—3 leaves 2.

Mortise.
A regular shaped incision made in a piece of wood to receive another piece named the tenon.

Newel Posts.
The large upright pieces which are built in with the stairs, usually ornamental.

Newel String.
The string of the stairs which is attached to the newel posts.

Notation.
The expression of quantities by figures or signs.

Numerator.
The upper figure in a fraction, as 7 in the fraction 7-8.

Numerical.
Composed of according to numbers.

Obscure.
Unknown or difficult to find out.

Octagon.
A figure having eight equal sides.

O. G.
A certain classical moulding with in and out curves.

Parallel lines
Lines at equal distance from each other all the way along.

Pediment.
A small gable, generally built on, rather than built into the main roof.

Per Space.
This term has been introduced to shorten the description of the work, thus, we can understand the rise per foot or per 12". Therefore the rise per space is the rise per 16", 18" or 20" as the case may be.

Pitch of roof.
The angle at which the roof rises.

Pitch Board.
A triangular piece of board used in laying out stairs, containing on one side the height of the riser and at right angles to it the width of the go.

Plan.

A plan drawing is one which gives a view as looked down upon from above.

Plane.

A plane or level surface may be horizontal as a level piece of land, or the term may be applied to an even surface of any kind, such as the plane of the earth's orbit in which the earth revolves round the sun, which is purely imaginary. So we have the plane of the surface of the roof, or the plane of the common rafter in the face of the gable, or the imaginary plane of the hip, which is vertical, or the plane of the back of the hip, which is sloping.

Planceer.

The part of the cornice attached to the wall.

Plan Method.

The term is used here to signify the system of obtaining cuts from the plan or from a horizontal scantling by ascertaining the amount to recede.

Plate.

The part of the building which the rafter rests upon.

Plumb Cut.

Generally means the cut which fits against the ridge, but may be applied to any vertical cut.

Plus.

Means more, or added to. The plus sign means when placed between two numbers that they are to be added together.

Point Cut.

The plumb cut at the upper end of the rafter.

Problem.

A complete question; to answer which requires an understanding of the subject.

Projection of rafter.

That part which overhangs the plate.

Proportion.

The relative comparison between two or more measurements or quantities, as we say, one scantling is twice as long as the other. That indicates the proportion that exists between them. If there was another scantling twice as long as the longest of those, the comparison or proportion would be the same between numbers 1 and 2 as it is between 2 and 3. If a fourth was to be had in the same proportion it would be twice as long as the third, and so on indefinitely. For further understanding, learn the arithmetical rule, or the steel square method of proportion.

Purlin.
A timber to support the rafters parallel with the plate, and between the plate and ridge.

Recede.
To go back. In this treatise to measure back the amount for the splay.

Rectangle.
A four sided figure, the opposite sides being parallel and of equal length, and all the angles right angles.

Ridge Line.
A line in the centre of the ridge.

Ridge Board.
The board in the centre of the roof between the points of the rafters.

Right angled triangle.
A triangle containing a square corner or right angle.

Rise per foot.
The pitch of a roof is described as so much rise per foot. A roof with a span of 8 feet and rise of 2 feet would rise 6" ~~feet~~ per foot, a span of 8 feet and rise of 3 feet would rise 9" feet per foot.

Riser.
In stairs, that board which fills the vacancy between tread and tread and supports the treads.

Roof Boards.
Those boards which are nailed to the rafters to receive the shingles, slate or other roof material.

Run of Stairs.
The entire distance travelled horizontally.

Scantling.
Small timbers from the size of 2" by 2" to 4" by 4".

Scale Drawing.
Drawing less or greater than full size, such as half size, quarter size, one inch to the foot, etc.

Scribing.
A system of fitting one piece to another by inscribing the shape of one on the other in a manner to guide in cutting.

Seat Cut.
The cut which prepares that part of the rafter which fits on the plate.

Section or Sectional View.
Suppose a building to be split in two and a drawing made of that surface it would be a sectional view.

Side Cut.
A cut which is not square across but makes one side shorter than the other.

Sizing.
The process of making all the pieces of the one size, as with the rafters. Hip valley and jack rafters must be the same depth where they pass over the plate.

Skew.
Anything not square or in line is on the skew.

Soffit.
The under part of the cornice from the facia to the wall.

Span of Building.
The width from side to side.

Spandrail.
A triangular surface, such as that from the string of the stairs to the floor.

Spiral.
Advancing in regular form as the thread on a screw.

Sphere.
A geometrical term to describe a round body, as a ball, earth, globe, etc.

Splay Cut.
See side cut, which is the same.

Square Root.
The square root of a number is a small number that when multiplied by itself gives the given number. The square root of 100 is 10, of 4, 2. The rule for extracting the square root is of infinite value to the work.

Statement.
An annoucement or description of certain facts.

Stair String.
The part which receives and supports the treads and risers.

Straight Edge.
A piece of wood or any other material of which one edge is made straight for use in straightening other work.

Stretchout.
Imagine a roof flattened out upon the ground, you would have a stretchout view of it. A stove pipe elbow before it is rolled into shape is a stretchout of the elbow.

Stud.
An upright piece such as used in walls and partitions.

Successive.
Following in order.

Summary.
A concise description.

Surplus.
An excess over the quantity required.

Tally.
An account or record kept.

Template.
A pattern or form used to work by.

Tenon.
The reduced end of a piece of wood which is placed in the mortise in another piece in the process of framing.

Terminate.
To end.

Transverse.
Cross.

Treads.
Those parts of the stairs upon which we walk.

Treatise.
A written explanation descriptive of subject.

Theoretical.
According to mental vision, thought, or calculation.

Unit.
A single thing.

Universal.
Unbounded unrestricted or pertaining to the whole universe.

Valley Rafter.
A rafter in an internal angle of the roof.

Vertical.
Plumb or perpendicular.

Wall String.
That string of the stairs which is attached to the wall.

Winders.

Stair treads which are wider at one end than at the other in order to make a turn.

Work Movements.

The term is applied to those positions of the square, etc., which are shown in the process of laying out the work.

Wreath.

In handrailing the term is applied to a piece of rail horizontally and vertically curved.

Rafter Table

DIRECTIONS FOR USE.

In this table it will be found that the first two columns contain the statement of the problem, namely the rise and the span. It being understood that we are dealing with even pitched roofs, these measurements will give us all that is required in order to obtain the essentials for laying out the rafters.

The third column will be the length of the common rafter. This leaves the two figures together which will be used for marking the splay cut of the jack rafter.

For this purpose apply the square to the edge of the scantling with the run and length of the common rafter. The side containing the length of the common rafter will be at the proper angle for the splay cut.

The fourth and fifth columns contain the run and length of the hip or valley; these columns also standing together will give the figures for marking the splay cut. By applying the square with the run and length of the hip or valley, the length side will give the angle required.

The sixth column gives the rise per foot; the seventh the rise per 16" (which will be found useful as shown in the lesson on jacks for the even pitched hip roof).

The eighth column gives the diminishing length of jack rafters in these examples. By diminishing of jacks is meant the difference in length between a jack rafter and the one next to it.

To find the diminishing for jacks of the following spacing it will not be difficult to apply the rule of proportion.

These rules will find the diminishing length for the space and rise required.

Take the diminishing length that it would require for 16" spacing and

For	18	inch	spacing	divide by	8	and	multiply by	9
"	20	"	"	"	4	"	"	5
"	22	"	"	"	8	"	"	11
"	24	"	"	"	2	"	"	3
"	30	"	"	"	8	"	"	15

Rafter Table

Rise.	Run.	Lengths to be used for marking splay cut of jacks. Length of common rafter.	Lengths to be used for marking splay cuts of hips and valleys. Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
1′	2′	2′ 2 27/32″	2′ 9 31/32″	3′	6″	8″	17 7/8″
1′ 6″	2′	2′ 6″	2′ 9 31/32″	3′ 2 13/32″	9″	12″	20″
2′	2′	2′ 9 31/32″	2′ 9 31/32″	3′ 5 19/32″	12″	16″	22 21/32″
1′	2′ 3″	2′ 5 9/16″	3′ 2 3/16″	3′ 4 1/32″	5 5/16″	7 1/8″	17 17/32″
1′ 6″	2′ 3″	2′ 8 7/16″	3′ 2 3/16″	3′ 6 7/32″	8″	10 21/32″	19 7/32″
2′	2′ 3″	3′ 1 1/8″	3′ 2 3/16″	3′ 9 3/32″	10 21/32″	14 7/32″	21 13/32″
2′ 6″	2′ 3″	3′ 4 3/8″	3′ 2 3/16″	4′ 9/16″	13 5/16″	17 25/32″	23 15/16″
1′	2′ 6″	2′ 8 5/16″	3′ 6 7/16″	3′ 8 3/32″	4 13/16″	6 13/32″	17 7/32″
1′ 6″	2′6″	2′ 11″	3′ 6 7/16″	3′ 10 3/32″	7 3/16″	9 19/32″	18 21/32″
2′	2′ 6″	3′ 2 13/32″	3′ 6 7/16″	4′ 3/4″	9 19/32″	12 13/16″	20 15/32″
2′ 6″	2′ 6″	3′ 6 7/16″	3′ 6 7/16″	4′ 3 31/32″	12″	16″	22 5/8″
1′	2′ 9″	2′ 11 1/8″	3′ 10 21/32″	4′ 3/16″	4 3/8″	5 13/16″	17 1/32″
1′ 6″	2′ 9″	3′ 1 19/32″	3′ 10 21/32″	4′ 2 1/32″	6 9/16″	8 23/32″	18 7/32″
2′	2′ 9″	3′ 4 13/16″	3′ 10 21/32″	4′ 4 15/32″	8 23/32″	11 5/8″	19 25/32
2′ 6″	2′ 9″	3′ 8 19/32″	3′ 10 21/32″	4′ 7 15/32″	10 29/32″	14 17/32″	21 5/8″

3'	2' 9"	4' 27/32"	3' 10 21/32"	4' 10 15/16"	13 3/32"	17 15/32"	23 11/16"
1' 6"	3'	3' 4 1/4"	4' 2 29/32"	4' 6"	6"	8"	17 7/8"
2'	3'	3' 7 9/32"	4' 2 29/32"	4' 8 9/32"	8"	10 21/32"	19 1/4"
2' 6"	3'	3' 10 7/8"	4' 2 29/32"	4' 11 3/32"	10"	13 11/32"	20 27/32"
3'	3'	4' 2 29/32"	4' 2 29/32"	5' 2 11/32"	12"	16"	22 5/8"
1' 6"	3' 3"	3' 6 31/32"	4'7 5/32"	4' 10 1/32"	5 17/32"	7 3/8"	17 5/8"
2'	3' 3"	3' 9 25/32"	4' 7 5/32"	5' 5/32"	7 3/8"	9 27/32"	18 25/32"
2' 6"	3' 3"	4' 1 3/16"	4' 7 5/32"	5' 2 25/32"	9 7/32"	12 5/16"	20 3/16"
3'	3' 3"	4' 5 1/16"	4' 7 5/32"	5' 5 7/8"	11 1/16"	14 25/32"	21 25/32"
3' 6"	3' 3"	4' 9 5/16"	4' 7 5/32"	5' 9 5/16"	12 15/16"	17 7/32"	23 1/2"
1' 6"	3' 6"	3' 9 11/16"	4' 11 13/32"	5' 2 1/16"	5 5/32"	6 27/32"	17 13/32"
2'	3' 6"	4' 3/8"	4' 11 13/32"	5' 4 1/16"	6 27/32"	9 5/32"	18 7/16"
2' 6"	3' 6"	4' 3 5/8"	4' 11 13/32"	5' 6 9/16"	8 9/16"	11 7/16"	19 21/32"
3'	3' 6"	4' 7 5/16"	4' 11 13/32"	5' 9 15/32"	10 9/32"	13 23/32"	21 1/16"
3' 6"	3' 6"	4' 11 13/32"	4' 11 13/32"	6' 3/4"	12"	16"	22 5/8"
1' 6"	3' 9"	4' 15/32"	5' 3 5/8"	5' 6 1/8"	4 13/16"	6 13/32"	17 7/32"
2'	3' 9"	4' 3"	5' 3 5/8"	5' 8"	6 13/32"	8 17/32"	18 1/8"
2' 6"	3' 9"	4' 6 3/32"	5' 3 5/8"	5' 10 11/32"	8"	10 21/32"	19 7/32"
3'	3' 9"	4' 9 5/8"	5' 3 5/8"	6' 1 1/8"	9 19/32"	12 13/16"	20 1/2"
3' 6"	3' 9"	5' 1 9/16"	5' 3 5/8"	6' 4 1/4"	11 3/16"	14 15/16"	21 7/8"
4'	3' 9"	5' 5 13/16"	5' 3 5/8"	6' 7 23/32"	12 13/16"	17 1/16"	23 13/32"
2'	4'	4' 5 21/32"	5' 7 7/8"	6'	6"	8"	17 7/8"
2' 6"	4'	4' 8 19/32"	5' 7 7/8"	6' 2 7/32"	7 1/2"	10"	18 7/8"
3'	4'	5'	5' 7 7/8"	6' 4 27/32"	9"	12"	20"

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inche.	Diminishing length of jacks.
3' 6"	4'	5' 3 25/32"	5' 7 7/8"	6' 7 13/16"	10 1/2"	14"	21 1/4"
4'	4'	5' 7 7/8"	5' 7 7/8"	6' 11 1/8"	12"	16"	22 5/8"
2'	4' 3"	4' 8 3/8"	6' 1/8"	6' 4"	5 21/32"	7 17/32"	17 11/16"
2' 6"	4' 3"	4' 11 5/32"	6' 1/8"	6' 6 1/8"	7 1/16"	9 13/32"	18 9/16"
3'	4' 3"	5' 2 7/16"	6' 1/8"	6' 8 5/8"	8 15/32"	11 9/32"	19 19/32"
3' 6"	4' 3"	5' 6 1/16"	6' 1/8"	6' 11 15/32"	9 7/8"	13 3/16"	20 23/32"
4'	4' 3"	5' 10 1/32"	6' 1/8"	7' 2 5/8"	11 9/32"	15 1/16"	21 31/32"
4' 6"	4' 3"	6' 2 9/32"	6' 1/8"	7' 6 3/32"	12 11/16"	16 15/16"	23 5/16"
2'	4' 6"	4' 11 3/32"	6' 4 3/8"	6' 8 1/16"	5 11/32"	7 1/8"	17 1/2"
2' 6"	4' 6"	5' 1 25/32"	6' 4 3/8"	6' 10 1/16"	6 21/32"	8 7/8"	18 5/16"
3'	4' 6"	5' 4 29/32"	6' 4 3/8"	7' 7/16"	8"	10 21/32	19 7/32"
3' 6"	4' 6"	5' 8 13/32"	6' 4 3/8"	7' 3 5/32"	9 11/32"	12 7/16"	20 9/32"
4'	4' 6"	6' 1/4"	6' 4 3/8"	7' 6 3/16"	10 21/32"	14 7/32"	21 13/32"
4' 6"	4' 6"	6' 4 3/8"	6' 4 3/8"	7' 9 17/32"	12"	16"	22 5/8"
2'	4' 9"	5' 1 27/32"	6' 8 5/8"	7' 3/32"	5 1/16"	6 3/4"	17 3/8"
2' 6"	4' 9"	5' 4 13/32"	6' 8 5/8"	7' 2"	6 5/16"	8 13/16"	18 3/32"
3'	4' 9"	5' 7 13/32"	6' 8 5/8"	7' 4 9/32"	7 19/32"	10 3/32"	18 15/16"
3' 6"	4' 9"	5' 10 13/16"	6' 8 5/8"	7' 6 29/32"	8 27/32"	11 25/32"	19 7/8"
4'	4' 9"	6' 2 17/32"	6' 8 5/8"	7' 9 13/16"	10 3/32"	13 15/32"	20 29/32"
4' 6"	4' 9"	6' 6 17/32"	6' 8 5/8"	8' 1 1/32"	11 3/8"	15 5/32"	22 1/32"
5'	4' 9"	6' 10 3/4"	6' 8 5/8"	8' 4 1/2"	12 5/8"	16 27/32"	23 7/32"
2' 6"	5'	5' 7 3/32"	7' 27/32"	7' 6"	6"	8"	17 7/8"

3′	5′	5′ 9 31/32″	7′ 27/32″	7′ 8 3/16″	7 3/16″	9 19/32″	18 21/32″
3′ 6″	5′	6′ 1 1/4″	7′ 27/32″	7′ 10 11/16″	8 13/32″	11 3/16″	19 17/32″
4′	5′	6′ 4 27/32″	7′ 27/32″	8′ 1 1/2″	9 19/32″	12 13/16″	20 1/2″
4′ 6″	5′	6′ 8 23/32″	7′ 27/32″	8′ 4 19/32″	10 13/16″	14 13/32″	21 17/32″
5′	5′	7′ 27/32″	7′ 27/32″	8′ 7 15/16″	12″	16″	22 5/8″
2′ 6″	5′ 3″	5′ 9 25/32″	7′ 5 3/32″	7′ 10″	5 23/32″	7 5/8″	17 23/32″
3′	5′ 3″	6′ 9/16″	7′ 5 3/32″	8′ 3/32″	6 27/32″	9 5/32″	18 7/16″
3′ 6″	5′ 3″	6′ 3 23/32″	7′ 5 3/32″	8′ 2 1/2″	8″	10 21/32″	19 7/32″
4′	5′ 3″	6′ 7 3/16″	7′ 5 3/32″	8′ 5 3/16″	9 5/32″	12 3/16″	20 1/8″
4′ 6″	5′ 3″	6′ 10 31/32″	7′ 5 3/32″	8′ 8 3/16″	10 9/32″	13 23/32″	21 1/16″
5′	5′ 3″	7′ 3″	7′ 5 3/32″	8′ 11 13/32″	11 7/16″	15 1/4″	22 3/32″
5′ 6″	5′ 3″	7′ 7 1/4″	7′ 5 3/32″	9′ 2 7/8″	12 9/16″	16 3/4″	23 3/16″
2′ 6″	5′ 6″	6′ 1/2″	7′ 9 11/32″	8′ 2 1/32″	5 15/32″	7 9/32″	17 9/16″
3′	5′ 6″	6′ 3 3/16″	7′ 9 11/32″	8′ 4 1/32″	6 17/32″	8 23/32″	18 7/32″
3′ 6″	5′ 6″	6′ 6 7/32″	7′ 9 11/32″	8′ 6 11/32″	7 5/8″	10 3/16″	18 31/32″
4′	5′ 6″	6′ 9 19/32″	7′ 9 11/32″	8′ 8 31/32″	8 23/32″	11 5/8″	19 25/32″
4′ 6″	5′ 6″	7′ 1 9/32″	7′ 9 11/32″	8′ 11 27/32″	9 13/16″	[illegible] 32″	20 11/16″
5′	5′ 6″	7′ 5 3/16″	7′ 9 11/32″	9′ 2 31/32″	10 29/32″	14 17/32″	21 5/8″
5′ 6″	5′ 6″	7′ 9 11/32″	7′ 9 11/32″	9′ 6 5/16″	12″	[illegible]	22 5/8″
2′ 6″	5′ 9″	6′ 3 1/4″	8′ 1 19/32″	8′ 6 3/32″	5 7/32″	6 31/32″	17 7/16″
3′	5′ 9″	6′ 5 13/16″	8′ 1 19/32″	8′ 8″	6 1/4″	8 11/32″	18 1/32″
3′ 6″	5′ 9″	6′ 8 25/32″	8′ 1 19/32″	8′ 10 1/4″	7 5/16″	9 3/4″	18 23/32″
4′	5′ 9″	7′ 1/16″	8′ 1 19/32″	9′ 3/4″	8 11/32″	11 1/8″	19 1/2″
4′ 6″	5′ 9″	7′ 3 5/8″	8′ 1 19/32″	9′ 3 17/32″	9 3/8″	12 17/32″	20 5/16″

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
5'	5' 9"	7' 7 7/16"	8' 1 19/32"	9' 6 9/16"	10 7/16"	13 29/32"	21 3/16"
5' 6"	5' 9"	7' 11 15/32"	8' 1 19/32"	9' 9 13/16"	11 15/32"	15 5/16"	22 1/8"
6'	5' 9"	8' 3 23/32"	8' 1 19/32"	10' 1 9/32"	12 17/32"	16 11/16"	23 1/8"
3'	6'	6' 8 1/2"	8' 5 13/16"	9'	6"	8"	17 7/8"
3' 6"	6'	6' 11 11/32"	8' 5 13/16"	9' 2 5/32"	7"	9 11/32"	18 17/32"
4'	6'	7' 2 17/32"	8' 5 13/16"	9' 4 9/16"	8"	10 21/32"	19 7/32"
4' 6"	6'	7' 6"	8' 5 13/16"	9' 7 1/4"	9"	12"	20"
5'	6'	7' 9 23/32"	8' 5 13/16"	9' 10 3/16"	10"	13 11/32"	20 13/16"
5' 6"	6'	8' 1 11/16"	8' 5 13/16"	10' 1 11/32"	11"	14 21/32"	21 23/32"
6'	6'	8' 5 13/16"	8' 5 13/16"	10' 4 23/32"	12"	16"	22 7/8"
3'	6' 3"	6' 11 3/16"	8' 10 1/16"	9' 4"	5 3/4"	7 11/16"	17 3/4"
3' 6"	6' 3"	7' 1 31/32"	8' 10 1/16"	9' 6 3/32"	6 23/32"	8 31/32"	18 11/32"
4'	6' 3"	7' 5 1/32"	8' 10 1/16"	9' 8 7/16"	7 11/16"	10 1/4"	19"
4' 6"	6' 3"	7' 8 13/32"	8' 10 1/16"	9' 11 1/32"	8 5/8"	11 17/32"	19 23/32"
5'	6' 3"	8' 1/32"	8' 10 1/16"	10' 1 7/8"	9 19/32"	12 13/16"	20 1/2"
5' 6"	6' 3"	8' 3 29/32"	8' 10 1/16"	10' 4 15/16"	10 9/16"	14 3/32"	21 5/16"
6'	6' 3"	8' 7 31/32"	8' 10 1/16"	10' 8 3/16"	11 17/32"	15 3/8"	22 3/16"
6' 6"	6' 3"	9' 7/32"	8' 10 1/16"	10' 11 21/32"	12 15/32"	16 5/8"	23 3/32"
3'	6' 6"	7' 1 29/32"	9' 2 5/16"	9' 8 1/32"	5 17/32"	7 3/8"	17 5/8"
3' 6"	6' 6"	7' 4 19/32"	9' 2 5/16"	9' 10 1/32"	6 15/32"	8 5/8"	18 3/16"
4'	6' 6"	7' 7 19/32"	9' 2 5/16"	10' 5/16"	7 3/8"	9 27/32"	18 25/32"
4' 6"	6' 6"	7' 10 7/8"	9' 2 5/16"	10' 2 13/16"	8 5/16"	11 1/16"	19 15/32"

5′	6′ 6″	8′ 2 13/32″	9′ 2 5/16″	10′ 5 9/16″	9 7/32″	12 5/16″	20 1/4″
5′ 6″	6′ 6″	8′ 6 3/16″	9′ 2 5/16″	10′ 8 17/32″	10 5/32″	13 17/32″	20 31/32″
6′	6′ 6″	8′ 10 5/32″	9′ 2 5/16″	10′ 11 23/32″	11 1/16″	14 25/32″	21 25/32″
6′ 6″	6′ 6″	9′ 2 5/16″	9′ 2 5/16″	11′ 3 3/32″	12″	16″	22 5/8″
3′	6′ 9″	7′ 4 5/8″	9′ 6 9/16″	10′ 1/16″	5 11/32″	7 1/8″	17 1/2″
3′ 6″	6′ 9″	7′ 7 1/4″	9′ 6 9/16″	10′ 2″	6 7/32″	8 9/32″	18 1/32″
4′	6′ 9″	7′ 10 5/32″	9′ 6 9/16″	10′ 4 3/16″	7 1/8″	9 15/32″	18 19/32″
4′ 6″	6′ 9″	8′ 1 11/32″	9′ 6 9/16″	10′ 6 21/32″	8″	10 21/32″	19 7/32″
5′	6′ 9″	8′ 4 13/16″	9′ 6 9/16″	10′ 9 5/16″	8 7/8″	11 27/32″	19 29/32″
5′ 6″	6′ 9″	8′ 8 1/2″	9′ 6 9/16″	11′ 7/32″	9 25/32″	13 1/32″	20 21/32″
6′	6′ 9″	9′ 3/8″	9′ 6 9/16″	11′ 3 5/16″	10 21/32″	14 7/32″	21 13/32″
6′ 6″	6′ 9″	9′ 4 15/32″	9′ 6 9/16″	11′ 6 19/32″	11 9/16″	15 13/32″	22 7/32″
7′	6′ 9″	9′ 8 11/16″	9′ 6 9/16″	11′ 10 1/16″	12 7/16″	16 19/32″	23 1/16″
3′ 6″	7′	7′ 9 29/32″	9′ 10 25/32″	10′ 6″	6″	8″	17 7/8″
4′	7′	8′ 3/4″	9′ 10 25/32″	10′ 8 1/8″	6 27/32″	9 5/32″	18 7/16″
4′ 6″	7′	8′ 3 7/8″	9′ 10 25/32″	10′ 10 1/2″	7 23/32″	10 9/32″	19 1/32″
5′	7′	8′ 7 7/32″	9′ 10 25/32″	11′ 1 3/32″	8 9/16″	11 7/16″	19 21/32″
5′ 6″	7′	8′ 10 13/16″	9′ 10 25/32″	11′ 3 29/32″	9 7/16″	12 9/16″	20 11/32″
6′	7′	9′ 2 5/8″	9′ 10 25/32″	11′ 6 29/32″	10 9/32″	13 23/32″	21 1/16″
6′ 6″	7′	9′ 6 5/8″	9′ 10 25/32″	11′ 10 1/8″	11 5/32″	14 27/32″	21 27/32″
7′	7′	9′ 10 25/32″	9′ 10 25/32″	12′ 1 1/2″	12″	16″	22 5/8″
3′ 6″	7′ 3″	8′ 19/32″	10′ 3 1/32″	10′ 10″	5 25/32″	7 23/32″	17 3/4″
4′	7′ 3″	8′ 3 3/8″	10′ 3 1/32″	11′ 1/16″	6 5/8″	8 13/16″	18 9/32″
4′ 6″	7′ 3″	8′ 6 13/32″	10′ 3 1/32″	11′ 2 3/8″	7 7/16″	9 15/16″	18 27/32″

Rise	Run	Length of common rafter	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
5′	7′ 3″	8′ 9 11/16″	10′ 3 1/32″	11′ 4 7/8″	8 9/32″	11 1/32″	19 7/16″
5′ 6″	7′ 3″	9′ 1 3/16″	10′ 3 1/32″	11′ 7 5/8″	9 3/32″	12 1/8″	20 3/32″
6′	7′ 3″	9′ 4 15/16″	10′3 1/32″	11′ 10 9/16″	9 15/16″	13 1/4″	20 25/32″
6′ 6″	7′ 3″	9′ 8 27/32″	10′ 3 1/32″	12′ 1 11/16″	10 3/4″	14 11/32″	21 1/2″
7′	7′ 3″	10′ 15/16″	10′ 3 1/32″	12′ 4 31/32″	11 19/32″	15 7/16″	22 1/4″
7′ 6″	7′ 3″	10′ 5 3/16″	10′ 3 1/32″	12′ 8 7/16″	12 13/32″	16 9/16″	23 1/32″
3′ 6″	7′ 6″	8′ 3 5/16″	10′ 7 9/32″	11′ 2 1/32″	5 19/32″	7 15/32″	17 21/32″
4′	7′ 6″	8′ 6″	10′ 7 9/32″	11′ 4 1/32″	6 13/32″	8 17/32″	18 1/8″
4′ 6″	7′ 6″	8′ 8 31/32″	10′ 7 9/32″	11′ 6 1/4″	7 3/16″	9 19/32″	18 21/32″
5′	7′ 6″	9′ 5 /32″	10′ 7 9/32″	11′ 8 23/32″	8″	10 21/32″	19 7/32″
5′ 6″	7′ 6″	9′ 3 19/32″	10′ 7 9/32″	11′ 11 3/8″	8 13/16″	11 23/32″	19 27/32″
6′	7′ 6″	9′ 7 1/4″	10′ 7 9/32″	12′ 2 7/32″	9 19/32″	12 13/16″	20 1/2″
6′ 6″	7′ 6″	9′ 11 3/32″	10′ 7 9/32″	12′ 5 9/32″	10 13/32″	13 7/8″	21 3/16″
7′	7′ 6″	10′ 3 1/8″	10′7 9/32″	12′ 8 1/2″	11 3/16″	14 15/16″	21 7/8″
7′ 6″	7′ 6″	10′ 7 9/32″	10′7 9/32″	12′ 11 7/8″	12″	16″	22 5/8″
3′ 6″	7′ 9″	8′ 6 1/32″	10′ 11 17/32″	11′ 6 1/16″	5 13/32″	7 7/32″	17 9/16″
4′	7′ 9″	8′ 8 21/32″	10′ 11 17/32″	11′ 8″	6 3/16″	8 1/4″	18″
4′ 6″	7′ 9″	8′ 11 17/32″	10′ 11 17/32″	11′ 10 3/16″	6 31/32″	9 9/32″	18 1/2″
5′	7′ 9″	9′ 2 11/16″	10′ 11 17/32″	12′ 9/16″	7 3/4″	10 5/16″	19 1/32″
5′ 6″	7′ 9″	9′ 6 1/32″	10′ 11 17/32″	12′ 3 5/32″	8 17/32″	11 11/32″	19 5/8″
6′	7′ 9″	9′ 9 5/8″	10′ 11 17/32″	12′ 5 15/16″	9 9/32″	12 3/8″	20 1/4″
6′ 6″	7′ 9″	10′ 1 3/8″	10′ 11 17/32″	12′ 8 29/32″	10 1/16″	13 13/32″	20 7/8″

7'	7' 9"	10' 5 5/16"	10' 11 17/32"	13' 1/16"	10 27/32"	14 7/16"	21 9/16"
7' 6"	7' 9"	10' 9 13/32"	10' 11 17/32"	13' 3 3/8"	11 5/8"	15 15/32"	22 1/4"
8'	7' 9"	11' 1 21/32"	10' 11 17/32"	13' 6 27/32"	12 3/8"	16 17/32"	23"
4'	8'	8' 11 11/32"	11' 3 3/4"	12'	6"	8"	17 29/32"
4' 6"	8'	9' 2 5/32"	11' 3 3/4"	12' 2 1/8"	6 3/4"	9"	18 3/8"
5'	8'	9' 5 7/32"	11' 3 3/4"	12' 4 7/16"	7 1/2"	10"	18 27/32"
5' 6"	8'	9' 8 1/2"	11' 3 3/4"	12' 6 31/32"	8 1/4"	11"	19 13/32"
6'	8'	10'	11' 3 3/4"	12' 9 11/16"	9"	12"	20"
6' 6"	8'	10' 3 11/16"	11' 3 3/4"	13' 9/16"	9 3/4"	13"	20 5/8"
7'	8'	10' 7 9/16"	11' 3 3/4"	13' 3 21/32"	10 1/2"	14"	21 1/4"
7' 6"	8'	10' 11 19/32"	11' 3 3/4"	13' 6 7/8"	11 1/4"	15"	21 15/16"
8'	8'	11' 3 3/4"	11' 3 3/4"	13' 10 9/32"	12"	16"	22 5/8"
4'	8' 3"	9' 2 1/32"	11' 8"	12' 4"	5 13/16"	7 3/4"	17 25/32"
4' 6"	8' 3"	9' 4 25/32"	11' 8"	12' 6 1/16"	6 17/32"	8 23/32"	18 7/32"
5'	8' 3"	9' 7 3/4"	11' 8"	12' 8 5/16"	7 9/32"	9 11/16"	18 23/32"
5' 6"	8' 3"	9' 10 31/32"	11' 8"	12' 10 25/32"	8"	10 21/32"	19 7/32"
6'	8' 3"	10' 2 13/32"	11' 8"	13' 1 7/16"	8 23/32"	11 5/8"	19 25/32"
6' 6	8' 3"	10' 6 1/32"	11' 8"	13' 4 9/32"	9 15/32"	12 19/32"	20 3/8"
7'	8' 3"	10' 9 27/32"	11' 8"	13' 7 9/32"	10 3/16"	13 9/16"	21"
7' 6"	8' 3"	11' 1 25/32"	11' 8"	13' 10 7/16"	10 29/32"	14 17/32"	21 5/8"
8'	8' 3"	11' 5 29/32"	11' 8"	14' 1 3/4"	11 5/8"	15 1/2"	22 9/32"
8' 6"	8' 3"	11' 10 5/32"	11' 8"	14' 5 7/32"	12 3/8"	16 1/2"	23"
4'	8' 6"	9' 4 23/32"	12' 1/4"	12' 8 1/32"	5 21/32"	7 17/32"	17 11/16"
4' 6"	8' 6"	9' 7 13/32"	12' 1/4"	12' 10 1/32"	6 11/32"	8 15/32"	18 3/32"

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches	Diminishing length of jacks.
5	8' 6"	9' 10 11/32"	12' 1/4"	13' 7/32"	7 1/16	9 13/32"	18 9/16"
5' 6"	8' 6"	10' 1 1/2"	12' 1/4"	13' 2 5/8"	7 3/4"	10 11/32"	19 1/16"
6'	8' 6"	10' 4 27/32"	12' 1/4"	13' 5 7/32"	8 15/32"	11 9/32"	19 19/32
6' 6"	8' 6"	10' 8 13/32"	12' 1/4"	13' 8"	9 3/16"	12 1/4"	20 5/32"
7'	8' 6"	11' 1/8"	12' 1/4"	13' 10 15/16"	9 7/8"	13 3/16"	20 23/32"
7' 6"	8' 6"	11' 4 1/32"	12' 1/4"	14' 2 1/32"	10 19/32"	14 1/8"	21 11/32"
8'	8' 6"	11' 8 1/16"	12' 1/4"	14' 5 9/32"	11 9/32"	15 1/16"	21 31/32"
8' 6"	8' 6"	12' 1/4"	12' 1/4"	14' 8 25/32"	12"	16"	22 5/8"
4'	8' 9"	9' 7 7/16"	12' 4 1/2"	13' 1/16"	5 1/2"	7 5/16"	17 19/32"
4' 6"	8' 9"	9' 10 1/16"	12' 4 1/2"	13' 2"	6 3/16	8 7/32"	18"
5'	8' 9"	10' 15/16"	12' 4 1/2"	13' 4 5/32"	6 27/32"	9 5/32"	18 7/16"
5' 6"	8' 9"	10' 4 1/32"	12' 4 1/2"	13' 6 1/2"	7 17/32"	10 1/16"	18 29/32"
6'	8' 9"	10' 7 5/16"	12' 4 1/2"	13' 9 1/32"	8 7/32"	10 31/32"	19 13/32"
6' 6"	8' 9"	10' 10 13/16"	12' 4 1/2"	13' 11 23/32"	8 29/32"	11 7/8"	19 15/16"
7'	8' 9"	11' 2 15/32"	12' 4 1/2"	14' 2 19/32"	9 19/32"	12 13/16"	20 1/2"
7' 6"	8' 9"	11' 6 9/32"	12' 4 1/2"	14' 5 5/8"	10 9/32"	13 23/32"	21 1/16"
8'	8' 9"	11' 10 9/32"	12' 4 1/2"	14' 8 13/16"	10 31/32"	14 5/8"	21 11/16"
8' 6"	8' 9"	12' 2 3/8"	12' 4 1/2"	15' 5/32	11 21/32"	15 17/32"	22 5/16"
9'	8' 9"	12' 6 5/8"	12' 4 1/2"	15' 3 5/8"	12 11/32"	16 15/32"	22 15/16'
4' 6"	9'	10' 3/4"	12' 8 3/4"	13' 6"	6"	8"	17 7/8"
5'	9'	10' 3 9/16"	12' 8 3/4"	13' 8 3/32"	6 21/32"	8 7/8"	18 5/16"
5' 6"	9'	10' 6 9/16"	12' 8 3/4"	13' 10 3/8"	7 11/32"	9 25/32"	18 3/4"

6'	9'	10' 9 13/16"	12' 8 3/4"	14' 27/32"	8"	10 21/32"	19 1/8"
6' 6"	9'	11' 1 7/32"	12' 8 3/4"	14' 3 1/2"	8 21/32"	11 9/16"	19 3/4"
7'	9'	11' 4 13/16"	12' 8 3/4"	14' 6 5/16"	9 11/32"	12 7/16"	20 9/32"
7' 6"	9'	11' 8 19/32"	12' 8 3/4"	14' 9 9/32"	10"	13 11/32"	20 13/16"
8'	9'	12' 1/2"	12' 8 3/4"	15' 13/32"	10 21/32"	14 7/32"	21 13/32"
8' 6"	9'	12' 4 9/16"	12' 8 3/4"	15' 3 21/32"	11 11/32"	15 1/8"	22"
9'	9'	12' 8 3/4"	12' 8 3/4"	15' 7 1/16"	12"	16"	22 5/8"
4' 6"	9' 3"	10' 3 7/16"	13' 31/32"	13' 10"	5 27/32"	7 25/32"	17 25/32"
5'	9' 3"	10' 6 3/16"	13' 31/32"	14' 1/16"	6 1/2"	8 21/32"	18 3/16"
5' 6"	9' 3"	10' 9 1/8"	13' 31/32"	14' 2 9/32"	7 1/8"	9 1/2"	18 5/8"
6'	9' 3"	11' 5/16"	13' 31/32"	14' 4 11/16"	7 25/32"	10 3/8"	19 1/16"
6' 6"	9' 3"	11' 3 21/32"	13' 31/32"	14' 7 9/32"	8 7/16"	11 1/4"	19 9/16"
7'	9' 3"	11' 7 3/16"	13' 31/32"	14' 10 1/32"	9 3/32"	12 1/8"	20 1/16"
7' 6"	9' 3"	11' 10 29/32"	13' 31/32"	15' 15/16"	9 23/32"	12 31/32"	20 19/32"
8'	9' 3"	12' 2 3/4"	13' 31/32"	15' 4"	10 3/8"	13 27/32"	21 5/32"
8' 6"	9' 3"	12' 6 3/4"	13' 31/32"	15' 7 7/32"	11 1/32"	14 11/16"	21 23/32"
9'	9' 3"	12' 10 7/8"	13' 31/32"	15' 10 17/32"	11 11/16"	15 9/16"	22 5/16"
9' 6"	9' 3"	13' 3 1/8"	13' 31/32"	16' 2"	12 5/16"	16 7/16"	22 15/16"
4' 6"	9' 6"	10' 6 5/32"	13' 5 7/32"	14' 2 1/32"	5 11/16"	7 19/32"	17 23/32"
5'	9' 6"	10' 8 13/16"	13' 5 7/32"	14' 4 1/32"	6 5/16"	8 13/32"	18 3/32"
5' 6"	9' 6"	10' 11 23/32"	13' 5 7/32"	14' 6 7/32"	6 15/16"	9 1/4"	18 1/2"
6'	9' 6"	11' 2 27/32"	13' 5 7/32"	14' 8 9/16"	7 19/32"	10 3/32"	18 15/16"
6' 6"	9' 6"	11' 6 1/8"	13' 5 7/32"	14' 11 3/32"	8 7/32"	10 15/16"	19 3/8"
7'	9' 6"	11' 9 19/32"	13' 5 7/32"	15' 1 25/32"	8 27/32"	11 25/32"	19 7/8"

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
7' 6"	9' 6"	12' 1 1/4"	13' 5 7/32"	15' 4 5/8"	9 15/32"	12 5/8"	20 3/8"
8'	9' 6"	12' 5 1/32"	13' 5 7/32"	15' 7 5/8"	10 3/32"	13 15/32"	20 29/32"
8' 6"	9' 6"	12' 8 31/32"	13' 5 7/32"	15' 10 25/32"	10 3/4"	14 5/16"	21 15/32"
9'	9' 6"	13' 1 1/32"	13' 5 7/32"	16' 2 1/16"	11 3/8"	15 5/32"	22 1/32"
9' 6"	9' 6"	13' 5 7/32"	13' 5 7/32"	16' 5 15/32"	12"	16"	22 5/8"
4' 6"	9' 9"	10' 8 7/8"	13' 9 15/32"	14' 6 1/16"	5 17/32"	7 3/8"	17 5/8"
5'	9' 9"	10' 11 1/2"	13' 9 15/32"	14' 8"	6 5/32"	8 7/32"	17 31/32"
5' 6"	9' 9"	11' 2 11/32"	13' 9 15/32"	14' 10 1/8"	6 25/32"	9 1/32"	18 3/8"
6'	9' 9"	11' 5 3/8"	13' 9 15/32"	15' 7/16"	7 3/8"	9 27/32"	18 25/32"
6' 6"	9' 9"	11' 8 5/8"	13' 9 15/32"	15' 2 15/16"	8"	10 21/32"	19 7/32"
7'	9' 9"	12' 1/32"	13' 9 15/32"	15' 5 9/16"	8 5/8"	11 1/2"	19 11/16"
7' 6"	9' 9"	12' 3 5/8"	13' 9 15/32"	15' 8 11/32"	9 7/32"	12 5/16"	20 3/16"
8'	9' 9"	12' 7 11/32"	13' 9 15/32"	15' 11 9/32"	9 27/32"	13 1/8"	20 11/16"
8' 6"	9' 9"	12' 11 7/32"	13' 9 15/32"	16' 2 3/8"	10 15/32"	13 15/16"	21 7/32"
9'	9' 9"	13' 3 7/32"	13' 9 15/32"	16' 5 19/32"	11 1/16"	14 25/32"	21 25/32"
9' 6"	9' 9"	13' 7 11/32"	13' 9 15/32"	16' 8 15/16"	11 11/16"	15 19/32"	22 11/32"
10'	9' 9"	13' 11 19/32"	13' 9 15/32"	17' 13/32"	12 5/16"	16 13/32"	22 29/32"
5'	10'	11' 2 5/32"	14' 1 23/32"	15'	6"	8"	17 7/8"
5' 6"	10'	11' 4 15/16"	14' 1 23/32"	15' 2 3/32"	6 19/32"	8 13/16"	18 1/4"
6'	10'	11' 7 15/16"	14' 1 23/32"	15' 4 11/32"	7 3/16"	9 19/32"	18 21/32"
6' 6"	10'	11' 11 1/8"	14' 1 23/32"	15' 6 25/32"	7 13/16"	10 13/32"	19 3/32"
7'	10'	12' 2 15/32"	14' 1 23/32"	15' 9 11/32"	8 13/32"	11 3/16"	19 17/32"

7' 6"	10'	12' 6"	14' 1 23/32"	16' 3/32"	9"	12"	20"
8'	10'	12' 9 11/16"	14' 1 23/32"	16' 2 31/32"	9 19/32"	12 13/16"	20 1/2"
8' 6"	10'	13' 1 1/2"	14' 1 23/32"	16' 6"	10 3/16"	13 19/32"	21"
9'	10'	13' 5 7/16"	14' 1 23/32"	16' 9 5/32"	10 13/16"	14 13/32"	21 17/32"
9' 6"	10'	13' 9 1/2"	14' 1 23/32"	17' 7/16"	11 13/32"	15 3/16"	22 1/16"
10'	10'	14' 1 23/32"	14' 1 23/32"	17' 3 27/32"	12"	16"	22 5/8"
5'	10' 3"	11' 4 27/32"	14' 5 15/16"	15' 4"	5 27/32"	7 13/16"	17 13/16"
5' 6"	10' 3"	11' 7 19/32"	14' 5 15/16"	15' 6 1/16"	6 7/16"	8 19/32"	18 5/32"
6'	10' 3"	11' 10 17/32"	14' 5 15/16"	15' 8 1/4"	7 1/32"	9 3/8"	18 17/32"
6' 6"	10' 3"	12' 1 21/32"	14' 5 15/16"	15' 10 5/8"	7 5/8"	10 5/32"	18 15/16"
7'	10' 3"	12' 4 15/16"	14' 5 15/16"	16' 1 5/32"	8 3/16"	10 15/16"	19 3/8"
7' 6"	10' 3"	12' 8 13/32"	14' 5 15/16"	16' 3 27/32"	8 25/32"	11 23/32"	19 13/16"
8'	10' 3"	13' 1 /32"	14' 5 15/16"	16' 6 11/16"	9 3/8"	12 1/2"	20 9/32"
8' 6"	10' 3"	13' 3 25/32"	14' 5 15/16"	16' 9 21/32"	9 15/16"	13 9/32"	20 25/32"
9'	10' 3"	13' 7 11/16"	14' 5 15/16"	17' 3/4"	10 17/32".	14 1/16"	21 9/32"
9' 6"	10' 3"	13' 11 23/32"	14' 5 15/16"	17' 3 31/32"	11 1/8"	14 13/16"	21 13/16"
10'	10' 3"	14' 3 27/32"	14' 5 15/16"	17' 7 5/16"	11 23/32"	15 5/8"	22 3/8"
10' 6"	10' 3"	14' 8 3/32"	14' 5 15/16"	17' 10 25/32"	12 9/32"	16 3/8"	22 29/32"
5'	10' 6"	11' 7 9/16"	14' 10 3/16"	15' 8 1/32"	5 23/32"	7 5/8"	17 23/32"
5' 6	10' 6"	11' 10 1/4"	14' 10 3/16"	15' 10 1/32"	6 9/32"	8 3/8"	18 1/16"
6'	10' 6"	12' 1 1/8"	14' 10 3/16"	16' 3/16"	6 27/32"	9 5/32"	18 7/16"
6' 6"	10' 6"	12' 4 3/16"	14' 10 3/16"	16' 2 1/2"	7 7/16"	9 29/32"	18 13/16"
7'	10' 6"	12' 7 7/16"	14' 10 3/16"	16' 5"	8"	10 21/32"	19 7/32"
7' 6"	10' 6"	12' 10 27/32"	14' 10 3/16"	16' 7 5/8"	8 9/16"	11 7/16"	19 21/32"

Rise.	Run.	Length of common rafter	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
8′	10′ 6″	13′ 2 13/32″	14′ 10 3/16″	16′ 10 13/32″	9 5/32″	12 3/16″	20 5/32″
8′ 6″	10′ 6″	13′ 6 1/8″	14′ 10 3/16″	17′ 1 5/16″	9 23/32″	12 15/16″	20 19/32″
9′	10′ 6″	13′ 9 15/16″	14′ 10 3/16″	17′ 4 3/8″	10 9/32″	13 23/32″	21 1/16″
9′ 6″	10′ 6″	14′ 1 29/32″	14′ 10 3/16″	17′ 7 17/32″	10 27/32′	14 15/32″	21 9/16″
10′	10′ 6″	14′ 6″	14′ 10 3/16″	17′ 10 27/32″	11 7/16″	15 1/4″	22 3/32″
10′ 6″	10′ 6″	14′ 10 3/16″	14′ 10 3/16″	18′ 2 1/4″	12″	16″	22 5/8″
5′	10′ 9″	11′ 10 9/32″	15′ 2 7/16″	16′ 1/16″	5 19/32″	7 7/16″	17 21/32″
5′ 6″	10′ 9″	12′ 29/32″	15′ 2 7/16″	16′ 2″	6 1/8″	8 3/16″	17 31/32″
6′	10′ 9″	12′ 3 23/32″	15′ 2 7/16″	16′ 4 1/8″	6 11/16″	8 15/16″	18 5/16″
6′ 6″	10′ 9″	12′ 6 3/4″	15′ 2 7/16″	16′ 6 13/32″	7 1/4″	9 11/16″	18 11/16″
7′	10′ 9″	12′ 9 15/16″	15′ 2 7/16″	16′ 8 27/32″	7 13/16″	10 13/32″	19 3/32″
7′ 6″	10′ 9″	13′ 1 9/32″	15′ 2 7/16″	16′ 11 7/16″	8 3/8″	11 5/32″	19 1/2″
8′	10′ 9″	13′ 4 13/16″	15′ 2 7/16″	17′ 2 5/32″	8 15/16″	11 29/32″	19 15/16″
8′ 6″	10′ 9″	13′ 8 15/32″	15′ 2 7/16″	17′ 5″	9 1/2″	12 21/32″	20 13/32″
9′	10′ 9″	14′ 1/4″	15′ 2 7/16″	17′ 8″	10 1/16″	13 13/32″	20 7/8″
9′ 6″	10′ 9″	14′ 4 5/32″	15′ 2 7/16″	17′ 11 1/8″	10 19/32″	14 1/8″	21 11/32″
10′	10′ 9″	14′ 8 3/16″	15′ 2 7/16″	18′ 2 3/8″	11 5/32″	14 7/8″	21 27/32″
10′ 6″	10′ 9″	15′ 5/16″	15′ 2 7/16″	18′ 5 23/32″	11 23/32″	15 5/8″	22 3/8″
11′	10′ 9″	15′ 4 9/16″	15′ 2 7/16″	18′ 9 3/16″	12 9/32″	16 3/8″	22 29/32″
5′ 6″	11′	12′ 3 19/32″	15′ 6 11/16″	16′ 6″	6″	8″	17 7/8″
6′	11′	12′ 6 3/8″	15′ 6 11/16″	16′ 8 3/32″	6 17/32″	8 23/32″	18 7/32″
6′ 6″	11′	12′ 9 5/16″	15′ 6 11/16″	16′ 10 5/16″	7 3/32″	9 15/32″	18 9/16″

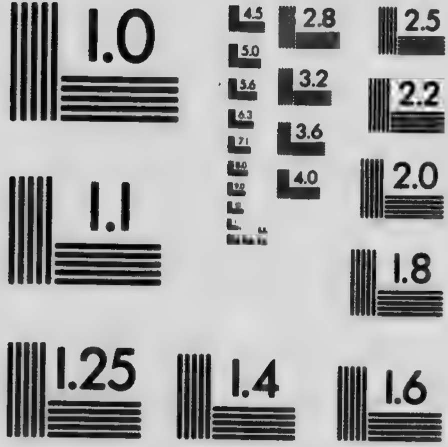
7'	11'	13' 15/32"	15' 6 11/16"	17' 23/32"	7 5/8"	10 3/16"	18 31/32"
7' 6"	11	13' 3 3/4"	15' 6 11/16"	17' 3 1/4"	8 3/16"	10 29/32"	19 3/8"
8'	11'	13' 7 7/32"	15' 6 11/16"	17' 5 29/32"	8 23/32"	11 5/8"	19 25/32"
8' 6"	11'	13' 10 13/16"	15' 6 11/16"	17' 8 23/32"	9 9/32"	12 3/8"	20 7/32"
9'	11'	14' 2 9/16"	15' 6 11/16"	17' 11 21/32"	9 13/16"	13 3/32"	20 11/16"
9' 6"	11'	14' 6 13/32"	15' 6 11/16"	18' 2 23/32"	10 3/8"	13 13/16"	21 1/8"
10'	11'	14' 10 13/32"	15' 6 11/16"	18' 5 29/32"	10 29/32"	14 17/32"	21 5/8"
10' 6"	11'	15' 2 15/32"	15' 6 11/16"	18' 9 7/32"	11 15/32"	15 9/32"	22 1/8"
11'	11'	15' 6 11/16"	15' 6 11/16"	19' 5/8"	12"	16"	22 5/8"
5' 6"	11' 3"	12' 6 9/32"	15' 10 29/32"	16' 10"	5 7/8"	7 13/16"	17 13/16"
6'	11' 3"	12' 9"	15' 10 29/32"	17' 1/32'	6 13/32"	8 17/32"	18 1/8"
6' 6"	11' 3"	12' 11 29/32"	15' 10 29/32"	17' 2 1/4"	6 15/16"	9 1/4"	18 15/32"
7'	11' 3"	13' 3"	15' 10 29/32"	17' 4 19/32"	7 15/32"	9 31/32"	18 27/32"
7' 6"	11' 3"	13' 6 1/4"	15' 10 29/32"	17' 7 1/16"	8"	10 21/32"	19 7/32"
8'	11' 3"	13' 9 21/32"	15' 10 29/32"	17' 9 11/16"	8 17/32"	11 3/8"	19 5/8"
8' 6"	11' 3"	14' 1 3/16"	15' 10 29/32"	18' 15/32"	9 1/16"	12 3/32"	20 1/16"
9'	11' 3"	14' 4 7/8"	15' 10 29/32"	18' 3 11/32"	9 19/32"	12 13/16"	20 1/2"
9' 6"	11' 3"	14' 8 11/16"	15' 10 29/32"	18' 6 3/8"	10 1/8"	13 1/2"	20 15/16"
10'	11' 3"	15' 5/8"	15' 10 29/32"	18' 9 1/2"	10 21/32"	14 7/32"	21 13/32"
10' 6"	11' 3"	15' 4 21/32"	15' 10 29/32"	19' 3/4"	11 3/16"	14 15/16"	21 7/8"
11'	11' 3"	15' 8 13/16"	15' 10 29/32"	19' 4 3/32"	11 23/32"	15 21/32"	22 3/8"
11' 6"	11' 3"	16' 1 1/16"	15' 10 29/32"	19' 7 9/16"	12 9/32"	16 11/32"	22 29/32"
5' 6"	11' 6"	12' 8 31/32	16' 3 5/32"	17' 2 1/32"	5 3/4"	7 21/32"	17 3/4"
6'	11' 6"	12' 11 21/32"	16' 3 5/32"	17' 4 1/32"	6 1/4"	8 11/32"	18 1/32"

Rise.	Run.	Length of common rafter	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
6' 6"	11' 6"	13' 2 17/32"	16' 3 5/32"	17' 6 5/32"	6 25/32"	9 1/32"	18 3/8"
7'	11' 6"	13' 5 9/16"	16' 3 5/32"	17' 8 15/32"	7 5/16"	9 3/4"	18 23/32"
7' 6"	11' 6"	13' 8 3/4"	16' 3 5/32"	17' 10 29/32"	7 13/16"	10 7/16"	19 3/32"
8'	11' 6"	14' 3/32"	16' 3 5/32"	18' 1 1/2"	8 11/32"	11 1/8"	19 1/2"
8' 6"	11' 6"	14' 3 19/32"	16' 3 5/32"	18' 4 7/32"	8 7/8"	11 13/16"	19 29/32"
9'	11' 6"	14' 7 1/4"	16' 3 5/32"	18' 7 1/16"	9 3/8"	12 17/32"	20 5/16"
9' 6"	11' 6"	14' 11"	16' 3 5/32"	18' 10 1/32"	9 29/32"	13 7/32"	20 3/4"
10'	11' 6"	15' 2 7/8"	16' 3 5/32"	19' 1 3/32"	10 7/16"	13 29/32"	21 3/16"
10' 6"	11' 6"	15' 6 7/8"	16' 3 5/32"	19' 4 5/16"	10 31/32"	14 19/32"	21 21/32"
11'	11' 6"	15' 10 31/32"	16' 3 5/32"	19' 7 5/8"	11 15/32"	15 5/16"	22 1/8"
11' 6"	11' 6"	16' 3 5/32"	16' 3 5/32"	19' 11 1/32"	12"	16"	22 5/8"
5' 6"	11' 9"	12' 11 11/16"	16' 7 13/32"	17' 6 1/32"	5 5/8"	7 1/2"	17 21/32"
6'	11' 9"	13' 2 5/16"	16' 7 13/32"	17' 8"	6 1/8"	8 5/32"	17 31/32"
6' 6"	11' 9"	13' 5 1/8"	16' 7 13/32"	17' 10 1/8"	6 5/8"	8 27/32"	18 9/32"
7'	11' 9"	13' 8 1/8"	16' 7 13/32"	18' 3/8"	7 5/32"	9 17/32"	18 5/8"
7' 6"	11' 9"	13' 11 9/32"	16' 7 13/32"	18' 2 25/32"	7 21/32"	10 7/32"	18 31/32"
8'	11' 9"	14' 2 19/32"	16' 7 13/32"	18' 5 5/16"	8 5/32"	10 29/32"	19 11/32"
8' 6"	11' 9"	14' 6 1/32"	16' 7 13/32"	18' 7 31/32"	8 11/16"	11 9/16"	19 3/4"
9'	11' 9"	14' 9 19/32"	16' 7 13/32"	18' 10 25/32"	9 3/16"	12 1/4"	20 5/32"
9' 6"	11' 9"	15' 1 5/16"	16' 7 13/32"	19' 1 11/16"	9 11/16"	12 15/16"	20 9/16"
10'	11' 9"	15' 5 5/32"	16' 7 13/32"	19' 4 23/32"	10 7/32"	13 5/8"	21"
10' 6"	11' 9"	15' 9 3/32"	16' 7 13/32"	19' 7 7/8"	10 23/32"	14 5/16"	21 15/32"

11′	11′ 9″	16′ 1 5/32″	16′ 7 13/32″	19′ 11 1/8″	11 1/4″	14 31/32″	21 29/32″
11′ 6″	11′ 9″	16′ 5 9/32″	16′ 7 13/32″	20′ 2 1/2″	11 3/4″	15 21/32″	22 3/8″
12′	11′ 9″	16′ 9 17/32″	16′ 7 13/32″	20′ 5 31/32″	12 1/4″	16 11/32″	22 7/8″
	12′	13′ 5″	16′ 11 21/32″	18′	6″	8″	17 7/8″
[illegible]	12′	13′ 7 25/32″	16′ 11 21/32″	18′ 2 1/16″	6 1/2″	8 21/32″	18 3/16″
[illegible]	12′	13′ 10 23/32″	16′ 11 21/32″	18′ 4 9/32″	7″	9 11/32″	18 17/32″
6″	12′	14′ 1 13/16″	16′ 11 21/32″	18′ 6 21/32″	7 1/2″	10″	18 7/8″
[illegible]	12′	14′ 5 1/16″	16′ 11 21/32″	18′ 9 1/8″	8″	10 21/32″	19 7/32″
8′ 6″	12′	14′ 8 15/32″	16′ 11 21/32″	18′ 11 3/4″	8 1/2″	11 11/32″	19 19/32″
9′	12′	15′	16′ 11 21/32″	19′ 2 1/2″	9″	12″	20″
9′ 6″	12′	15′ 3 21/32″	16′ 11 21/32″	19′ 5 3/8″	9 1/2″	12 21/32″	20 13/32″
10′	12′	15′ 7 7/16″	16′ 11 21/32″	19′ 8 3/8″	10″	13 5/16″	20 13/16″
10′ 6″	12′	15′ 11 11/32″	16′ 11 21/32″	19′ 11 15/32″	10 1/2″	14″	21 1/4″
11′	12′	16′ 3 11/32″	16′ 11 21/32″	20′ 2 11/16″	11″	14 21/32″	21 23/32″
11′ 6″	12′	16′ 7 7/16″	16′ 11 21/32″	20′ 6″	11 1/2″	15 11/32″	22 5/32″
12′	12′	16′ 11 21/32″	16′ 11 21/32″	26′ 9 13/32″	12″	16″	22 5/8″
6′	12′ 3″	13′ 7 11/16″	17′ 3 7/8″	18′ 4″	5 7/8″	7 27/32″	17 13/16″
6′ 6″	12′ 3″	13′ 10 13/32″	17′ 3 7/8″	18′ 6 1/32″	6 3/8″	8 1/2″	18 1/8″
7′	12′ 3″	14′ 1 5/16″	17′ 3 7/8″	18′ 8 7/32″	6 27/32″	9 5/32″	18 7/16″
7′ 6″	12′ 3″	14′ 4 3/8″	17′ 3 7/8″	18′ 10 17/32″	7 11/32″	9 25/32″	18 3/4″
8′	12′ 3″	14′ 7 9/16″	17′ 3 7/8″	19′ 31/32″	7 27/32″	10 7/16″	19 3/32″
8′ 6″	12′ 3″	14′ 10 29/32″	17′ 3 7/8″	19′ 3 9/16″	8 5/16″	11 3/32″	19 15/32″
9′	12′ 3″	15′ 2 13/32″	17′ 3 7/8″	19′ 6 9/32″	8 13/16″	11 3/4″	19 27/32″
9′ 6″	12′ 3″	15′ 6 1/32″	17′ 3 7/8″	19′ 9 3/32″	9 5/16″	12 13/32″	20 1/4″

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



APPLIED IMAGE Inc
1653 East Main Street
Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
10′	12′ 3″	15′ 9 3/4″	17′ 3 7/8″	20′ 1/32″	9 25/32″	13 1/16″	20 21/32″
10′ 6″	12′ 3″	16′ 1 5/8″	17′ 3 7/8″	20′ 3 3/32″	10 9/32″	13 23/32″	21 1/16″
11′	12′ 3″	16′ 5 9/16″	17′ 3 7/8″	20′ 6 1/4″	10 25/32″	14 3/8″	21 1/2″
11′ 6″	12′ 3″	16′ 9 5/8″	17′ 3 7/8″	20′ 9 17/32″	11 1/4″	15 1/32″	21 15/16″
12′	12′ 3″	17′ 1 25/32″	17′ 3 7/8″	21′ 29/32″	11 3/4″	15 11/16″	22 13/32″
12′ 6″	12′ 3″	17′ 6 1/32″	17′ 3 7/8″	21′ 4 11/32″	12 1/4″	16 5/16″	22 7/8″
6′	12′ 6″	13′ 10 3/8″	17′ 8 1/8″	18′ 8 1/32″	5 3/4″	7 11/16″	17 3/4″
6′ 6″	12′ 6″	14′ 1 1/16″	17′ 8 1/8″	18′ 10 1/32″	6 1/4″	8 5/16″	18 1/32″
7′	12′ 6″	14′ 3 29/32″	17′ 8 1/8″	19′ 15/32″	6 23/32″	8 31/32″	18 11/32″
7′ 6″	12′ 6″	14′ 6 15/16″	17′ 8 1/8″	19′ 2 7/16″	7 3/16″	9 19/32″	18 21/32″
8′	12′ 6″	14′ 10 3/32″	17′ 8 1/8″	19′ 4 27/32″	7 11/16″	10 1/4″	19″
8′ 6″	12′ 6″	15′ 1 13/32″	17′ 8 1/8″	19′ 7 3/8″	8 5/32″	10 7/8″	19 11/32″
9′	12′ 6″	15′ 4 27/32″	17′ 8 1/8″	19′ 10 1/32″	8 5/8″	11 17/32″	19 23/32″
9′ 6″	12′ 6″	15′ 8 13/32″	17′ 8 1/8″	20′ 13/16″	9 1/8″	12 5/32″	20 3/32″
10′	12′ 6″	16′ 3/32″	17′ 8 1/8″	20′ 3 23/32″	9 19/32″	12 13/16″	20 1/2″
10′ 6″	12′ 6″	16′ 3 29/32″	17′ 8 1/8″	20′ 6 23/32″	10 3/32″	13 7/16″	20 29/32″
11′	12′ 6″	16′ 7 13/16″	17′ 8 1/8″	20′ 9 27/32″	10 9/16″	14 1/16″	21 5/16″
11′ 6″	12′ 6″	16′ 11 13/16″	17′ 8 1/8″	21′ 1 1/16″	11 1/32″	14 23/32″	21 3/4″
12′	12′ 6″	17′ 3 15/16″	17′ 8 1/8″	21′ 4 13/32″	11 17/32″	15 3/8″	22 3/16″
12′ 6″	12′ 6″	17′ 8 1/8″	17′ 8 1/8″	21′ 7 13/16″	12″	16″	22 5/8″
6′	12′ 9″	14′ 1 3/32″	18′ 3/3″	19′ 1/32″	5 21/32″	7 17/32″	17 11/16″
6′ 6″	12′ 9″	14′ 3 3/4″	18′ 3/8″	19′ 2″	6 1/8″	8 5/32″	17 31/32″

7′	12′ 9″	14′ 6 17/32″	18′ 3/8″	19′ 4 3/32″	6 9/16″	8 25/32″	18 1/4″
7′ 6″	12′ 9″	14′ 9 1/2″	18′ 3/8″	19′ 6 11/32″	7 1/16″	9 13/32″	18 9/16″
8′	12′ 9″	15′ 5/8″	18′ 3/8″	19′ 8 23/32″	7 17/32″	10 1/32″	18 7/8″
8′ 6″	12′ 9″	15′ 3 7/8″	18′ 3/8″	19′ 11 7/32″	8″	10 21/32″	19 7/32″
9′	12′ 9″	15′ 7 9/32″	18′ 3/8″	20′ 1 27/32″	8 15/32″	11 9/32″	19 19/32″
9′ 6″	12′ 9″	15′ 10 13/16″	18′ 3/8′	20′ 4 9/16″	8 15/16″	11 15/16″	19 15/16″
10′	12′ 9″	16′ 2 7/16″	18′ 3/8″	20′ 7 7/16″	9 13/32″	12 9/16″	20 11/32″
10′ 6″	12′ 9″	16′ 6 7/32″	18′ 3/8″	20′ 10 3/8″	9 7/8″	13 3/16″	20 23/32″
11′	12′ 9″	16′ 10 1/16″	18′ 3/8″	21′ 1 15/32″	10 11/32″	13 13/16″	21 1/8″
11′ 6″	12′ 9″	17′ 2 1/32″	18′ 3/8″	21′ 4 5/8″	10 13/16″	14 7/16″	21 17/32″
12′	12′ 9″	7′ 6 3/32″	18′ 3/8″	21′ 7 29/32″	11 9/32″	15 1/16″	21 31/32″
12′ 6″	12′ 9″	17′ 10 1/4″	18′ 3/8″	21′ 11 9/32″	11 3/4″	15 11/16″	22 13/32″
13′	12′ 9″	18′ 2 1/2″	18′ 3/8″	22′ 2 3/4″	12 1/4″	16 5/16″	22 27/32″
6′ 6″	13′	14′ 6 13/32″	18′ 4 5/8″	19′ 6″	6″	8″	17 7/8″
7′	13′	14′ 9 3/16″	18′ 4 5/8″	19′ 8 1/16″	6 15/32″	8 5/8″	18 3/16″
7′ 6″	13′	15′ 3/32″	18′ 4 5/8″	19′ 10 9/32″	6 15/16″	9 7/32″	18 15/32″
8′	13′	15′ 3 3/16″	18′ 4 5/8″	20′ 19/32″	7 3/8″	9 27/32″	18 25/32″
8′ 6″	13′	15′ 6 3/8″	18′ 4 5/8″	20′ 3 1/16″	7 27/32″	10 15/32″	19 1/8″
9′	13′	15′ 9 3/4″	18′ 4 5/8″	20′ 5 5/8″	8 5/16″	11 1/16″	19 15/32″
9′ 6″	13′	16′ 1 7/32″	18′ 4 5/8″	20′ 8 11/32″	8 25/32″	11 11/16″	19 13/16″
10′	13′	16′ 4 13/16″	18′ 4 5/8″	20′ 11 5/32″	9 7/32″	12 5/16″	20 3/16″
10′ 6″	13′	16′ 8 17/32″	18′ 4 5/8″	21′ 2 1/16″	9 11/16″	12 15/16″	20 9/16″
11′	13′	17′ 11/32″	18′ 4 5/8″	21′ 5 3/32″	10 5/32″	13 17/32″	20 31/32″
11′ 6″	13′	17′ 4 9/32″	18′ 4 5/8″	21′ 8 7/32″	10 5/8″	14 5/32″	21 3/8″

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminish length of jacks.
12'	13'	17' 8 5/16"	18' 4 5/8"	21' 11 15/32"	11 1/16"	14 25/32"	21 25/32"
12' 6"	13'	18' 13/32"	18' 4 5/8"	22' 2 25/32"	11 17/32"	15 3/8"	22 3/16"
13'	13'	18' 4 5/8"	18' 4 5/8"	22' 6 3/16"	12"	16"	22 5/8"
6' 6"	13' 3"	14' 9 3/32"	18' 8 7/8"	19' 10"	5 7/8"	7 27/32"	17 13/16"
7'	13' 3"	14' 11 13/16"	18' 8 7/8"	20' 1/32"	6 11/32"	8 7/16"	18 3/32"
7' 6"	13'3"	15' 2 23/32"	18' 8 7/8"	20' 2 3/16"	6 25/32"	9 1/16"	18 3/8"
8'	13' 3"	15' 5 23/32"	18' 8 7/8"	20' 4 1/2"	7 1/4"	9 21/32"	18 11/16"
8' 6"	13' 3"	15' 8 29/32"	18' 8 7/8"	20' 6 29/32"	7 11/16"	10 1/4"	19"
9'	13' 3"	16' 7/32"	18' 8 7/8"	20' 9 7/16"	8 5/32"	10 7/8"	19 11/32"
9' 6"	13' 3"	16' 3 21/32"	18' 8 7/8"	21' 3/32"	8 19/32"	11 15/32"	19 11/16"
10'	13' 3"	16' 7 3/16"	18' 8 7/8"	21' 2 7/8"	9 1/16"	12 1/16"	20 1/32"
10' 6"	13' 3"	16' 10 7/8"	18' 8 7/8"	21' 5 3/4"	9 1/2"	12 11/16"	20 13/32"
11'	13' 3"	17' 2 21/32"	18' 8 7/8"	21' 8 3/4"	9 31/32"	13 9/32"	20 13/16"
11' 6"	13' 3"	17' 6 17/32"	18' 8 7/8"	21' 11 27/32"	10 13/32"	13 7/8"	21 3/16"
12'	13' 3"	17' 10 17/32"	18' 8 7/8"	22' 3 1/32"	10 7/8"	14 1/2"	21 19/32"
12' 6"	13' 3"	18' 2 19/32"	18' 8 7/8"	22' 6 5/16"	11 5/16"	15 3/32"	22"
13'	13' 3"	18' 6 3/4"	18' 8 7/8"	22' 9 11/16"	11 25/32"	15 11/16"	22 13/32"
13' 6"	13' 3"	18' 11"	18' 8 7/8"	23' 1 1/8"	12 7/32"	16 5/16"	22 27/32"
6' 6"	13' 6"	14' 11 13/16"	19' 1 3/32"	20' 2 1/32"	5 25/32"	7 23/32"	17 3/4"
7'	13' 6"	15' 2 15/32"	19' 1 3/32"	20' 4 1/32"	6 7/32"	8 9/32"	18 1/32"
7' 6"	13' 6"	15' 5 5/16"	19' 1 3/32	20' 6 5/32"	6 21/32"	8 7/8"	18 5/16"
8'	13' 6"	15' 8 5/16"	19' 1 3/32"	20' 8 13/32"	7 1/8"	9 15/32"	18 19/32"

8′ 6″	13′ 6″	15′ 11 7/16″	19′ 1 3/32″	20′ 10 25/32″	7 9/16″	10 1/16″	18 29/32″
9′	13′ 6″	16′ 2 11/16″	19′ 1 3/32″	21′ 1 9/32″	8″	10 21/32″	19 7/32″
9′ 6″	13′ 6″	16′ 6 3/32″	19′ 1 3/32″	21′ 3 29/32″	8 7/16″	11 1/4″	19 9/16″
10′	13′ 6″	16′ 9 19/32″	19′ 1 3/32″	21′ 6 5/8″	8 7/8″	11 27/32″	19 29/32″
10′ 6″	13′ 6″	17′ 1 7/32″	19′ 1 3/32″	21′ 9 15/32″	9 11/32″	12 7/16″	20 9/32″
11′	13′ 6″	17′ 4 31/32″	19′ 1 3/32″	22′ 13/32″	9 25/32″	13 1/32″	20 5/8″
11′ 6″	13′ 6″	17′ 8 13/16″	19′ 1 3/32″	22′ 3 15/32″	10 7/32″	13 5/8″	21 1/32″
12′	13′ 6″	18′ 3/4″	19′ 1 3/32″	22′ 6 19/32″	10 21/32″	14 7/32″	21 13/32″
12′ 6″	13′ 6″	18′ 4 25/32″	19′ 1 3/32″	22′ 9 27/32″	11 1/8″	14 13/16″	21 13/16″
13′	13′ 6″	18′ 8 29/32″	19′ 1 3/32″	23′ 1 3/16″	11 9/16″	15 13/32″	22 7/32″
13′ 6″	13′ 6″	19′ 1 3/32″	19′ 1 3/32″	23′ 4 19/32″	12″	16″	22 5/8″
6′ 6″	13′ 9″	15′ 2 1/2″	19′ 5 11/32″	20′ 6 1/32″	5 11/16″	7 9/16″	17 11/16″
7′	13′ 9″	15′ 5 5/32″	19′ 5 11/32″	20′ 8″	6 1/8″	8 5/32″	17 31/32″
7′ 6″	13′ 9″	15′ 7 15/16″	19′ 5 11/32″	20′ 10 3/32″	6 17/32″	8 23/32″	18 7/32″
8′	13′9″	15′ 10 29/32″	19′ 5 11/32″	21′ 5/16″	6 31/32″	9 5/16″	18 1/2″
8′ 6″	13′ 9″	16′ 1 31/32″	19′ 5 11/32″	21′ 2 21/32″	7 13/32″	9 29/32″	18 13/16″
9′	13′ 9″	16′ 5 3/16″	19′ 5 11/32″	21′ 5 1/8″	7 27/32″	10 15/32″	19 1/8″
9′ 6″	13′ 9″	16′ 8 9/16″	19′ 5 11/32″	21′ 7 23/32″	8 9/32″	11 1/16″	19 7/16″
10′	13′ 9″	17′ 1/32″	19′ 5 11/32″	21′ 10 13/32″	8 23/32″	11 5/8″	19 25/32″
10′ 6″	13′ 9′	17′ 3 19/32″	19′ 5 11/32″	22′ 1 3/16″	9 5/32″	12 7/32″	20 1/8″
11′	13′ 9″	17′ 7 5/16″	19′ 5 11/32″	22′ 4 3/32″	9 19/32″	12 13/16″	20 1/2″
11′ 6″	13′ 9″	17′ 11 3/32″	19′ 5 11/32″	22′ 7 3/32″	10 1/32″	13 3/8″	20 27/32″
12′	13′ 9″	18′ 3″	19′ 5 11/32″	22′ 10 3/16″	10 15/32″	13 31/32″	21 1/4″
12′ 6″	13′ 9″	18′ 7″	19′ 5 11/32″	23′ 1 13/32″	10 27/32″	14 17/32″	21 5/8″

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
13′	13′ 9″	18′ 11 1/16″	19′ 5 11/32″	23′ 4 11/16″	11 11/32″	15 1/8″	22 1/32″
13′ 6″	13′ 9″	19′ 3 7/32″	19′ 5 11/32″	23′ 8 1/16″	11 25/32″	15 23/32″	22 13/32″
14′	13′ 9″	19′ 7 15/32″	19′ 5 11/32″	23′ 11 17/32″	12 7/32″	16 9/32″	22 27/32″
7′	14′	15′ 7 27/32″	19′ 9 19/32″	21′	6″	8″	17 7/8″
7′ 6″	14′	15′ 10 19/32″	19′ 9 19/32″	21′ 2 1/16″	6 7/16″	8 9/16″	18 5/32″
8′	14′	16′ 1 1/2″	19′ 9 19/32″	21′ 4 1/4″	6 27/32″	9 5/32″	18 7/16″
8′ 6″	14′	16′ 4 17/32″	19′ 9 19/32″	21′ 6 9/16″	7 9/32″	9 23/32″	18 23/32″
9′	14′	16′ 7 23/32″	19′ 9 19/32″	21′ 8 31/32″	7 23/32″	10 9/32″	19 1/32″
9′ 6″	14′	16′ 11 1/32″	19′ 9 19/32″	21′ 11 17/32″	8 5/32″	10 27/32″	19 11/32″
10′	14′	17′ 2 15/32″	19′ 9 19/32″	22′ 2 3/16″	8 9/16″	11 7/16″	19 21/32″
10′ 6″	14′	17′ 6″	19′ 9 19/32″	22′ 4 15/16″	9″	12″	20″
11′	14′	17′ 9 21/32″	19′ 9 19/32″	22′ 7 25/32″	9 7/16″	12 9/16″	20 11/32″
11′ 6″	14′	18′ 1 13/32″	19′ 9 19/32″	22′ 10 3/4″	9 27/32″	13 5/32″	20 23/32″
12′	14′	18′ 5 9/32″	19′ 9 19/32″	23′ 1 13/16″	10 9/32″	13 23/32″	21 1/16″
12′ 6″	14′	18′ 9 7/32″	19′ 9 19/32″	23′ 4 31/32″	10 23/32″	14 9/32″	21 7/16″
13′	14′	19′ 1 1/4″	19′ 9 19/32″	23′ 8 7/32″	11 5/32″	14 27/32″	21 27/32″
13′ 6″	14′	19′ 5 3/8″	19′ 9 19/32″	23′ 11 9/16″	11 9/16″	15 7/16″	22 7/32″
14′	14′	19′ 9 19/32″	19′ 9 19/32″	24′ 3″	12″	16″	22 5/8″
7′	14′ 3″	15′ 10 17/32″	20′ 1 27/32″	21′ 4″	5 29/32″	7 27/32″	17 13/16″
7′ 6″	14′ 3″	16′ 1 1/4″	20′ 1 27/32″	21′ 6 1/32″	6 5/16″	8 13/32″	18 3/32″
8′	14′ 3″	16′ 4 3/32″	20′ 1 27/32″	21′ 8 3/16″	6 3/4″	8 31/32″	18 11/32″
8′ 6″	14′ 3″	16′ 7 1/8″	20′ 1 27/32″	21′ 10 15/32″	7 5/32″	9 17/32″	18 5/8″

9′	14′ 3″	16′ 10 1/4″	20′ 1 27/32″	22′ 27/32″	7 19/32″	10 3/32″	18 15/16″
9′ 6″	14′ 3″	17′ 1 17/32″	20′ 1 27/32″	22′ 3 11/32″	8″	10 21/32″	19 7/32″
10′	14′ 3″	17′ 4 29/32″	20′ 1 27/32″	22′ 5 31/32″	8 7/16″	11 7/32″	19 9/16″
10′ 6″	14′ 3″	17′ 8 13/32″	20′ 1 27/32″	22′ 8 11/16″	8 27/32″	11 25/32″	19 29/32″
11′	14′ 3″	18′ 1/32″	20′ 1 27/32″	22′ 11 1/2″	9 1/4″	12 11/32″	20 7/32″
11′ 6″	14′ 3″	18′ 3 3/4″	20′ 1 27/32″	23′ 2 7/16″	9 11/16″	12 29/32″	20 9/16″
12′	14′ 3″	18′ 7 9/16″	20′ 1 27/32″	23′ 5 15/32″	10 3/32″	13 15/32″	20 29/32″
12′ 6″	14′ 3″	18′ 11 15/32″	20′ 1 27/32″	23′ 8 9/16″	10 17/32″	14 1/32″	21 9/32″
13′	14′ 3″	19′ 3 15/32″	20′ 1 27/32″	23′ 11 25/32″	10 15/16″	14 19/32″	21 21/32″
13′ 6″	14′ 3″	19′ 7 9/16″	20′ 1 27/32″	24′ 3 1/16″	11 3/8″	15 5/32″	22 1/32″
14′	14′ 3″	19′ 11 23/32″	20′ 1 27/32″	24′ 6 15/32″	11 25/32″	15 23/32″	22 7/16″
14′ 6″	14′ 3″	20′ 3 31/32″	20′ 1 27/32″	24′ 9 15/16″	12 7/32″	16 9/32″	22 13/16″
7′	14′ 6″	16′ 1 7/32″	20′ 6 1/16″	21′ 8 1/32″	5 25/32″	7 23/32″	17 25/32″
7′ 6″	14′ 6″	16′ 3 29/32″	20′ 6 1/16″	21′ 10 1/32″	6 7/32″	8 9/32″	18″
8′	14′ 6″	16′ 6 23/32″	20′ 6 1/16″	22′ 1/8″	6 5/8″	8 13/16″	18 9/32″
8′ 6″	14′ 6″	16′ 9 11/16″	20′ 6 1/16″	22′ 2 3/8″	7 1/32″	9 3/8″	18 17/32″
9′	14′ 6″	17′ 25/32″	20′ 6 1/16″	22′ 4 23/32″	7 7/16″	9 15/16″	18 27/32″
9′ 6″	14′ 6″	17′ 4 1/32″	20′ 6 1/16″	22′ 7 3/16″	7 7/8″	10 15/32″	19 1/8″
10′	14′ 6″	17′ 7 3/8″	20′ 6 1/16″	22′ 9 25/32″	8 9/32″	11 1/32″	19 7/16″
10′ 6″	14′ 6″	17′ 10 27/32″	20′ 6 1/16″	23′ 15/32″	8 11/16″	11 19/32″	19 3/4″
11′	14′ 6″	18′ 2 13/32″	20′ 6 1/16″	23′ 3 1/4″	9 3/32″	12 1/8″	20 3/32″
11′ 6″	14′ 6″	18′ 6 3/32″	20′ 6 1/16″	23′ 6 1/8″	9 17/32″	12 11/16″	20 7/16″
12′	14′ 6″	18′ 9 27/32″	20′ 6 1/16″	23′ 9 1/8″	9 15/16″	13 1/4″	20 25/32″
12′ 6″	14′ 6″	19′ 1 23/32″	20′ 6 1/16″	24′ 3/16″	10 11/32″	13 25/32″	21 1/8″

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
13′	14′ 6″	19′ 5 11/16″	20′ 6 1/16″	24′ 3 11/32″	10 3/4″	14 11/32″	21 1/2″
13′ 6″	14′ 6″	19′ 9 3/4″	20′ 6 1/16″	24′ 6 5/8″	11 3/16″	14 29/32″	21 7/8″
14′	14′ 6″	20′ 1 7/8″	20′ 6 1/16″	24′ 9 31/32″	11 19/32″	15 7/16″	22 1/4″
14′ 6″	14′ 6″	20′ 6 1/16″	20′ 6 1/16″	25′ 1 3/8″	12″	16″	22 5/8″
7′	14′ 9″	16′ 3 29/32″	20′ 10 5/16″	22′ 1/32″	5 11/16″	7 19/32″	17 23/32″
7′ 6″	14′ 9″	16′ 6 9/16″	20′ 10 5/16″	22′ 2″	6 3/32″	8 1/8″	17 29/32″
8′	14′ 9″	16′ 9 11/32″	20′ 10 5/16″	22′ 4 3/32″	6 1/2″	8 11/16″	18 3/16″
8′ 6″	14′ 9″	17′ 9/32″	20′ 10 5/16″	22′ 6 5/16″	6 29/32″	9 7/32″	18 15/32″
9′	14′ 9″	17′ 3 11/32″	20′ 10 5/16″	22′ 8 5/8″	7 5/16″	9 3/4″	18 3/4″
9′ 6″	14′ 9″	17′ 6 17/32″	20′ 10 5/16″	22′ 11 1/16″	7 23/32″	10 5/16″	19 1/32″
10′	14′ 9″	17′ 9 27/32″	20′ 10 5/16″	23′ 1 19/32″	8 1/8″	10 27/32″	19 11/32″
10′ 6″	14′ 9″	18′ 1 9/32″	20′ 10 5/16″	23′ 4 1/4″	8 17/32″	11 3/8″	19 21/32″
11′	14′ 9″	18′ 4 13/16″	20′ 10 5/16″	23′ 7″	8 15/16″	11 15/16″	19 31/32″
11′ 6″	14′ 9″	18′ 8 7/16″	20′ 10 5/16″	23′ 9 27/32″	9 11/32″	12 15/32″	20 9/32″
12′	14′ 9″	19′ 3/16″	20′ 10 5/16″	24′ 25/32″	9 3/4″	13 1/32″	20 5/8″
12′ 6″	14′ 9″	19′ 4″	20′ 10 5/16″	24′ 3 13/16″	10 5/32″	13 9/16″	20 31/32″
13′	14′ 9″	19′ 7 15/16″	20′ 10 5/16″	24′ 6 15/16″	10 9/16″	14 3/32″	21 5/16″
13′ 6″	14′ 9″	19′ 11 15/16″	20′ 10 5/16″	24′ 10 5/32″	10 31/32″	14 21/32″	21 11/16″
14′	14′ 9″	20′ 4 1/32″	20′ 10 5/16″	25′ 1 15/32″	11 3/8″	15 3/16″	22 1/16″
14′ 6″	14′ 9″	20′ 8 7/32″	20′ 10 5/16″	25′ 4 27/32″	11 13/16″	15 23/32″	22 7/16″
15′	14′ 9″	21′ 7/16″	20′ 10 5/16″	25′ 8 5/16″	12 3/16″	16 9/32″	22 13/16″
7′ 6″	15′	16′ 9 1/4″	21′ 2 9/16″	22′ 6″	6″	8″	17 7/8″

8′	15′	17′	21′ 2 9/16″	22′ 8 1/16″	6 13/32″	8 17/32″	18 1/8″
8′ 6″	15′	17′ 2 29/32″	21′ 2 9/16″	22′ 10 7/32″	6 13/16″	9 1/16″	18 13/32″
9′	15′	17′ 5 29/32″	21′ 2 9/16″	23′ 17/32″	7 3/16″	9 19/32″	18 21/32″
9′ 6″	15′	17′ 9 1/16″	21′ 2 9/16″	23′ 2 29/32″	7 19/32″	10 1/8″	18 15/16″
10′	15′	18′11/32″	21′ 2 9/16″	23′ 5 7/16″	8″	10 21/32″	19 7/32″
10′ 6″	15′	18′ 3 23/32″	21′ 2 9/16″	23′ 8 1/32″	8 13/32″	11 3/16″	19 17/32″
11′	15′	18′ 7 7/32″	21′ 2 9/16″	23′ 10 3/4″	8 13/16″	11 23/32″	19 27/32″
11′ 6″	15′	18′ 10 13/16″	21′ 2 9/16″	24′ 1 9/16″	9 3/16″	12 9/32″	20 5/32″
12′	15′	19′ 2 17/32″	21′ 2 9/16″	24′ 4 15/32″	9 19/32″	12 13/16″	20 1/2″
12′ 6″	15′	19′ 6 5/16″	21′ 2 9/16″	24′ 7 15/32″	10″	13 5/16″	20 13/16″
13′	15′	19′ 10 3/16″	21′ 2 9/16″	24′ 10 9/16″	10 13/32″	13 7/8″	21 3/16″
13′ 6″	15′	20′ 2 5/32″	21′ 2 9/16″	25′ 1 3/4″	10 13/16″	14 13/32″	21 17/32″
14′	15′	20′ 6 7/32″	21′ 2 9/16″	25′ 5″	11 3/16″	14 15/16″	21 7/8″
14′ 6″	15′	20′ 10 11/32″	21′ 2 9/16″	25′ 8 11/32″	11 19/32″	15 15/32″	22 1/4″
15′	15′	21′ 2 9/16″	21′ 2 9/16″	25′ 11 25/32″	12″	16″	22 5/8″
7′ 6″	15′ 3″	16′ 11 15/16″	21′ 6 13/16″	22′ 10″	5 29/32″	7 7/8″	17 27/32″
8′	15′ 3″	17′ 2 21/32″	21′ 6 13/16″	23′ 1/32″	6 9/32″	8 13/32″	18 1/16″
8′ 6″	15′ 3″	17′ 5 1/2″	21′ 6 13/16″	23′ 2 3/16″	6 11/16″	8 29/32″	18 5/16″
9′	15′ 3″	17′ 8 1/2″	21′ 6 13/16″	23′ 4 7/16″	7 3/32″	9 7/16″	18 19/32″
9′ 6″	15′ 3″	17′ 11 19/32″	21′ 6 13/16″	23′ 6 25/32″	7 15/32″	9 31/32″	18 27/32″
10′	15′ 3″	18′ 2 27/32″	21′ 6 13/16″	23′ 9 9/32″	7 7/8″	10 1/2″	19 1/8″
10′ 6″	15′ 3″	18′ 6 3/16″	21′ 6 13/16″	23′ 11 27/32″	8 1/4″	11″	19 7/16″
11′	15′ 3″	18′ 9 5/8″	21′ 6 13/16″	24′ 2 17/32″	8 21/32″	11 17/32″	19 23/32″
11′ 6″	15′ 3″	19′ 1 3/16″	21′ 6 13/16″	24′ 5 9/32″	9 1/16″	12 1/16″	20 1/32″

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
12′	15′ 3″	19′ 4 7/8″	21′ 6 13/16″	24′ 8 5/32″	9 7/16″	12 19/32″	20 3/8″
12′ 6″	15′ 3″	19′ 8 5/8″	21′ 6 13/16″	24′ 11 1/8″	9 27/32″	13 1/8″	20 11/16″
13′	15′ 3″	20′ 15/32″	21′ 6 13/16″	25′ 2 3/16″	10 7/32″	13 5/8″	21 1/32″
13′ 6″	15′ 3″	20′ 4 13/32″	21′ 6 13/16″	25′ 5 5/16″	10 5/8″	14 5/32″	21 3/8″
14′	15′ 3″	20′ 8 13/32″	21′ 6 13/16″	25′ 8 9/16″	11″	14 11/16″	21 23/32″
14′ 6″	15′ 3″	21′ 17/32″	21′ 6 13/16″	25′ 11 27/32″	11 13/32″	15 7/32″	22 3/32″
15′	15′ 3″	21′ 4 11/16″	21′ 6 13/16″	26′ 3 1/4″	11 13/16″	15 3/4″	22 7/16″
15′ 6″	15′ 3″	21′ 8 15/16″	21′ 6 13/16″	26′ 6 23/32″	12 3/16″	16 1/4″	22 13/16″
7′ 6″	15′ 6″	17′ 2 5/8″	21′ 11 1/32″	23′ 2 1/32″	5 13/16″	7 3/4″	17 25/32″
8′	15′ 6″	17′ 5 5/16″	21′ 11 1/32″	23′ 4″	6 3/16″	8 1/4″	18″
8′ 6″	15′ 6″	17′ 8 1/8″	21′ 11 1/32″	23′ 6 1/8″	6 19/32″	8 25/32″	18 1/4″
9′	15′ 6″	17′ 11 3/32″	21′ 11 1/32″	23′ 8 11/32″	6 31/32″	9 9/32″	18 1/2″
9′ 6″	15′ 6″	18′ 2 5/32″	21′ 11 1/32″	23′ 10 11/16″	7 11/32″	9 13/16″	18 25/32″
10′	15′ 6″	18′ 5 11/32″	21′ 11 1/32″	24′ 1 1/8″	7 3/4″	10 5/16″	19 1/32″
10′ 6″	15′ 6″	18′ 8 21/32″	21′ 11 1/32″	24′ 3 21/32″	8 1/8″	10 27/32″	19 5/16″
11′	15′ 6″	19′ 3/32″	21′ 11 1/32″	24′ 6 5/16″	8 17/32″	11 11/32″	19 5/8″
11′ 6″	15′ 6″	19′ 3 19/32″	21′ 11 1/32″	24′ 9 1/32″	8 29/32″	11 7/8″	19 29/32″
12′	15′ 6″	19′ 7 7/32″	21′ 11 1/32″	24′ 11 7/8″	9 9/32″	12 3/8″	20 7/32″
12′ 6″	15′ 6″	19′ 10 15/16″	21′ 11 1/32″	25′ 2 13/16″	9 11/16″	12 29/32″	20 9/16″
13′	15′ 6″	20′ 2 3/4″	21′ 11 1/32″	25′ 5 13/16″	10 1/16″	13 13/32″	20 7/8″
13′ 6″	15′ 6″	20′ 6 21/32″	21′ 11 1/32″	25′ 8 15/16″	10 7/16″	13 15/16″	21 7/32″
14′	15′ 6″	20′ 10 5/8″	21′ 11 1/32″	26′ 1/8″	10 27/32″	14 7/16″	21 9/16″

14′ 6″	15′ 6″	21′ 2 11/16″	21′ 11 1/32″	26′ 3 3/8″	11 7/32″	14 31/32″	21 29/32″
15′	15′ 6″	21′ 6 27/32″	21′ 11 1/32″	26′ 6 3/4″	11 5/8″	15 15/32″	22 1/4″
15′ 6″	15′ 6″	21′ 11 1/32″	21′ 11 1/32″	26′ 10 5/32″	12″	16″	22 5/8″
7′ 6″	15′ 9″	17′ 5 11/32″	22′ 3 9/32″	23′ 6 1/32″	5 23/32″	7 5/8″	17 23/32″
8′	15′ 9″	17′ 7 31/32″	22′ 3 9/32″	23′ 8″	6 3/32″	8 1/8″	17 15/16″
8′ 6″	15′ 9″	17′ 10 25/32″	22′ 3 9/32″	23′ 10 3/32″	6 15/32″	8 5/8″	18 3/16″
9′	15′ 9″	18′ 1 11/16″	22′ 3 9/32″	24′ 9/32″	6 27/32″	9 5/32″	18 7/16″
9′ 6″	15′ 9″	18′ 4 23/32″	22′ 3 9/32″	24′ 2 19/32″	7 1/4″	9 21/32″	18 11/16″
10′	15′ 9″	18′ 7 7/8″	22′ 3 9/32″	24′ 5″	7 5/8″	10 5/32″	18 15/16″
10′ 6″	15′ 9″	18′ 11 5/32″	22′ 3 9/32″	24′ 7 1/2″	8″	10 21/32″	19 7/32″
11′	15′ 9″	19′ 2 17/32″	22′ 3 9/32″	24′ 10 3/32″	8 3/8″	11 3/16″	19 1/2″
11′ 6″	15′ 9″	19′ 6 1/32″	22′ 3 9/32″	25′ 13/16″	8 3/4″	11 11/16″	19 13/16″
12′	15′ 9″	19′ 9 19/32″	22′ 3 9/32″	25′ 3 19/32″	9 5/32″	12 3/16″	20 1/8″
12′ 6″	15′ 9″	20′ 1 9/32″	22′ 3 9/32″	25′ 6 1/2″	9 17/32″	12 11/16″	20 7/16″
13′	15′ 9″	20′ 5 1/16″	22′ 3 9/32″	25′ 9 15/32″	9 29/32″	13 3/16″	20 3/4″
13′ 6″	15′ 9″	20′ 8 15/16″	22′ 3 9/32″	26′ 9/16″	10 9/32″	13 23/32″	21 1/16″
14′	15′ 9″	21′ 7/8″	22′ 3 9/32″	26′ 3 11/16″	10 21/32″	14 7/32″	21 13/32″
14′ 6″	15′ 9″	21′ 4 29/32″	22′ 3 9/32″	26′ 6 15/16″	11 1/32″	14 23/32″	21 3/4″
15′	15′ 9″	21′ 9″	22′ 3 9/32″	26′ 10 1/4″	11 7/16″	15 1/4″	22 3/32″
15′ 6″	15′ 9″	22′ 1 3/16″	22′ 3 9/32″	27′ 1 5/8″	11 13/16″	15 3/4″	22 7/16″
16′	15′ 9″	22′ 5 13/32″	22′ 3 9/32″	27′ 5 3/32″	12 3/16″	16 1/4″	22 13/16″
8′	16′	17′ 7 31/32″	22′ 7 17/32″	24′	6″	8″	17 21/32″
8′ 6″	16′	18′ 1 13/32″	22′ 7 17/32″	24′ 2 1/16″	6 3/8″	8 1/2″	18 1/8″
9′	16′	18′ 4 9/32″	22′ 7 17/32″	24′ 4 7/32″	6 3/4″	9″	18 11/32″

Rise.	Run.	Length of common rafter.	Run of hip.	Length of hip.	Rise per foot.	Rise per 16 inches.	Diminishing length of jacks.
9′ 6″	16′	18′ 7 9/32″	22′ 7 17/32″	24′ 6 1/2″	7 1/8″	9 1/2″	18 19/32″
10′	16′	18′ 10 13/16″	22′ 7 17/32″	24′ 8 7/8″	7 1/2″	10″	18 29/32″
10′ 6″	16′	19′ 1 21/32″	22′ 7 17/32″	24′ 11 11/32″	7 7/8″	10 1/2″	19 1/8″
11′	16′	19′ 5″	22′ 7 17/32″	25′ 1 29/32″	8 1/4″	11″	19 13/32″
11′ 6″	16′	19′ 8 7/16″	22′ 7 17/32″	25′ 4 19/32″	8 5/8″	11 1/2″	19 11/16″
12′	6′	20′	22′ 7 17/32″	25′ 7 11/32″	9″	12″	20″
12′ 6″	16′	20′ 3 21/32″	22′ 7 17/32″	25′ 10 7/32″	9 3/8″	12 1/2″	20 5/16″
13′	16′	20′ 7 3/8″	22′ 7 17/32″	26′ 1 5/32″	9 3/4″	13″	20 5/8″
13′ 6″	16′	20′ 11 7/32″	22′ 7 17/32″	26′ 4 3/16″	10 1/8″	13 1/2″	20 15/16″
14′	16′	21′ 3 1/8″	22′ 7 17/32″	26′ 7 5/16″	10 1/2″	14″	21 1/4″
14′ 6″	16′	21′ 7 1/8″	22′ 7 17/32″	26′ 10 1/2″	10 7/8″	14 1/2″	21 19/32″
15′	16′	21′ 11 3/16″	22′ 7 17/32″	27′ 1 [illegible]/32″	11 1/4″	15″	21 15/16″
15′ 6″	16′	22′ 3 5/16″	22′ 7 17/32″	27′ 5 1/8″	11 5/8″	15 1/2″	22 9/32″
16′	16′	22′ 7 17/32″	22′ 7 17/32″	27′ 8 9/16″	12″	16″	22 5/8″

Stair Table

It is not expected that this table will make it possible for a novice to build stairs without learning the principles of the work, and being able to figure the rise and go, for himself.

The purpose of this table is to save time, and to be used as a check by those who understand the work. Merely the calculations are performed; no suggestion as to design is included.

In the first column the measurement to be divided is stated, including from seven to one hundred and sixty-eight inches.

The second column contains the number of risers or treads as the case may be.

The column to the right contains the height of each riser or the width of each go as required.

For treads, the same as for risers it is an operation of dividing a distance into equal parts, so the same table will therefore serve both cases.

It is a good old custom to lay out a stair rod the height from floor to floor and spread the compasses to the distance stated for the height of the riser and step it off. It seldom takes more than three times to bring it out accurately. Then mark the compass point marks with the square and lay out the places for landings according to this rod.

It will be found that this rod is very useful in the process of the work and is a great check in the figuring and often saves mistakes.

STAIR TABLE.

7 ÷ 1 = 7″.

8 ÷ 1 = 8″.

9 ÷ 1 = 9″.
“ ÷ 2 = 4 1/2″ .5

10 ÷ 1 = 10″
“ ÷ 2 = 5″

11 ÷ 1 = 11″
“ ÷ 2 = 5 1/2″ .5

12 ÷ 1 = 12″
“ ÷ 2 = 6″

13 ÷ 1 = 13″
“ ÷ 2 = 6 1/2″ .5

14 ÷ 1 = 14″
“ ÷ 2 = 7″

15 ÷ 1 = 15″
“ ÷ 2 = 7 1/2″ .5

16 ÷ 2 = 8″
“ ÷ 3 = 5 11/32″ .3333

17 ÷ 2 = 8 1/2″ .5
“ ÷ 3 = 5 21/32″ .6667

18 ÷ 2 = 9″
“ ÷ 3 = 6″

19 ÷ 2 = 9 1/2″ .5
“ ÷ 3 = 6 11/32″ .3333

20 ÷ 2 = 10″
“ ÷ 3 = 6 21/32″ .6667

21 ÷ 2 = 10 1/2″ .5
“ ÷ 3 = 7″

22 ÷ 2 = 11″
“ ÷ 3 = 7 11/32″ .3333

23 ÷ 2 = 11 1/2″ .5
“ ÷ 3 = 7 21/32″ .6667
“ ÷ 4 = 5 3/4″ .75

24 ÷ 2 = 12″
“ ÷ 3 = 8″
“ ÷ 4 = 6″

25 ÷ 2 = 12 1/2″ .5
“ ÷ 3 = 8 11/32″ .3333
“ ÷ 4 = 6 1/4″ .25

26 ÷ 2 = 13″
“ ÷ 3 = 8 21/32″ .6667
“ ÷ 4 = 6 1/2″ .5

27 ÷ 2 = 13 1/2″ .5
“ ÷ 3 = 9″
“ ÷ 4 = 6 3/4″ .75

28 ÷ 2 = 14″
“ ÷ 3 = 9 11/32″ .3333
“ ÷ 4 = 7″

29 ÷ 3 = 9 21/32″ .6667
“ ÷ 4 = 8 1/4″ .25
“ ÷ 5 = 5 13/16″ .8

30 ÷ 3 = 10″
“ ÷ 4 = 7 1/2″ .5
“ ÷ 5 = 6″

31 ÷ 3 = 10 11/32″ .3333
“ ÷ 4 = 7 3/4″ .75
“ ÷ 5 = 6 3/16″ .20

32 ÷ 3 = 10 21/32″ .6667
“ ÷ 4 = 8″
“ ÷ 5 = 6 13/32″ .40

33 ÷ 3 = 11″
“ ÷ 4 = 8 1/4″ .25
“ ÷ 5 = 6 19/32″ .60

34 ÷ 3 = 11 11/32″ .3333
“ ÷ 4 = 8 1/2″ .5
“ ÷ 5 = 6 13/16″ .8

35 ÷ 3 = 11 21/32″ .6667
“ ÷ 4 = 8 3/4″ .75
“ ÷ 5 = 7″

36 ÷ 3 = 12″
“ ÷ 4 = 9″
“ ÷ 5 = 7 3/16″ .20
“ ÷ 6 = 6″

37 ÷ 4 = 9 1/4″ .25
“ ÷ 5 = 7 13/32″ .40
“ ÷ 6 = 6 5/32″ .1667

38 ÷ 4 = 9 1/2″ .5
“ ÷ 5 = 7 19/32″ .6
“ ÷ 6 = 6 11/32″ .3333

39 ÷ 4 = 9 3/4″ .75
“ ÷ 5 = 7 13/16″ .8
“ ÷ 6 = 6 1/2″ .5

40 ÷ 4 = 10″
“ ÷ 5 = 8″
“ ÷ 6 = 6 21/32″ .6667

41 ÷ 4 = 10 1/4″ .25
“ ÷ 5 = 8 3/16″ .20
“ ÷ 6 = 6 27/32″ .8333

42 ÷ 4 = 10 1/2″ .5
“ ÷ 5 = 8 13/32″ .4
“ ÷ 6 = 7″

43 ÷ 4 = 10 3/4″ .75
“ ÷ 5 = 8 19/32″ .6
“ ÷ 6 = 7 5/32″ .1667
“ ÷ 7 = 6 5/32″ .1429

44 ÷ 4 = 11″
“ ÷ 5 = 8 13/16″ .80
“ ÷ 6 = 7 11/32″ .3333
“ ÷ 7 = 6 9/32″ .2857

45 ÷ 4 = 11 1/4″ .25
“ ÷ 5 = 9″
“ ÷ 6 = 7 1/2″ .5
“ ÷ 7 = 6 7/16″ .4286

46 ÷ 4 = 11 1/2″ .5
“ ÷ 5 = 9 3/16″ .20
“ ÷ 6 = 7 21/32″ .6667
“ ÷ 7 = 6 9/16″ .5714

47 ÷ 4 = 11 3/4″ .75
“ ÷ 5 = 9 13/32″ .40
“ ÷ 6 = 7 27/32″ .8333
“ ÷ 7 = 6 23/32″ .7143

48 ÷ 4 = 12″
“ ÷ 5 = 9 19/32″ .6
“ ÷ 6 = 8″
“ ÷ 7 = 6 27/32″ .8571

49 ÷ 4 = 12 1/4″ .25
“ ÷ 5 = 9 13/16″ .80
“ ÷ 6 = 8 5/32″ .1667
“ ÷ 7 = 7″

50 ÷ 4 = 12 1/2″ .5
“ ÷ 5 = 10″
“ ÷ 6 = 8 11/32″ .3333
“ ÷ 7 = 7 5/32″ .1429
“ ÷ 8 = 6 1/4″ .25

51 ÷ 4 = 12 3/4″ .75
“ ÷ 5 = 10 3/16″ .20
“ ÷ 6 = 8 1/2″ .5
“ ÷ 7 = 7 9/32″ .2857
“ ÷ 8 = 6 3/8″ .375

52 ÷ 4 = 13″
“ ÷ 5 = 10 13/32″ .40
“ ÷ 6 = 8 21/32″ .6667
“ ÷ 7 = 7 7/16″ [illegible]
“ ÷ 8 = 6 1/2″ .5

53 ÷ 4 = 13 1/4″ .2500
“ ÷ 5 = 10 19/32″ .6000
“ ÷ 6 = 8 27/32″ .8333
“ ÷ 7 = 7 9/16″ .5714
“ ÷ 8 = 6 5/8″ .6250

54 ÷ 4 = 13 1/4″ .2500
“ ÷ 5 = 10 13/16″ .8000
“ ÷ 6 = 9″
“ ÷ 7 = 7 23/32″ .7143
“ ÷ 8 = 6 3/4″ .7500

55 ÷ 4 = 13 3/4″ .7500
“ ÷ 5 = 11″
“ ÷ 6 = 9 5/32″ .1667
“ ÷ 7 = 7 27/32″ .8571
“ ÷ 8 = 6 7/8″ .8750

56 ÷ 4 = 14″
“ ÷ 5 = 11 3/16″ .2000
“ ÷ 6 = 9 11/32″ .3333
“ ÷ 7 = 8″
“ ÷ 8 = 7″

57 ÷ 4 = 14 1/4″ .2500
“ ÷ 5 = 11 13/32″ .4000
“ ÷ 6 = 9 1/2″ .5000
“ ÷ 7 = 8 5/32″ .1429
“ ÷ 8 = 7 1/8″ .1250
“ ÷ 9 = 6 11/32″ .3333

58 ÷ 4 = 14 1/2″ .5000
“ ÷ 5 = 11 19/32″ .6000
“ ÷ 6 = 9 2/3″ .6667
“ ÷ 7 = 8 9/32″ .2857

58 ÷ 8 = 7 1/4″ .2500
“ ÷ 9 = 6 7/16″ .4444

59 ÷ 4 = 14 3/4″ .7500
“ ÷ 5 = 11 13/16″ .8000
“ ÷ 6 = 9 27/32″ .8333
“ ÷ 7 = 8 7/16″ .4286
“ ÷ 8 = 7 3/8″ .3750
“ ÷ 9 = 6 9/16″ .5556

60 ÷ 5 = 12″
“ ÷ 6 = 10″
“ ÷ 7 = 8 9/16″ .5714
“ ÷ 8 = 7 1/2″ .5000
“ ÷ 9 = 6 21/32″ .6667

61 ÷ 5 = 12 3/16″ .2000
“ ÷ 6 = 10 5/32″ .1667
“ ÷ 7 = 8 23/32″ .7143
“ ÷ 8 = 7 5/8″ .6250
“ ÷ 9 = 6 25/32″ .7778

62 ÷ 5 = 12 13/32″ .4000
“ ÷ 6 = 10 11/32″ .3333
“ ÷ 7 = 8 27/32″ .8571
“ ÷ 8 = 7 3/4″ .7500
“ ÷ 9 = 6 7/8″ .8889

63 ÷ 5 = 12 19/32″ .6000
“ ÷ 6 = 10 1/2″ .5000
“ ÷ 7 = 9″
“ ÷ 8 = 7 7/8″ .8750
“ ÷ 9 = 7″

64 ÷ 5 = 12 13/16″ .8000
“ ÷ 6 = 10 21/32″ .6667
“ ÷ 7 = 9 5/32″ .1429
“ ÷ 8 = 8″
“ ÷ 9 = 7 1/8″ .1111
“ ÷ 10 = 6 13/32″ .4000

65 ÷ 5 = 13″
“ ÷ 6 = 10 27/32″ .8333
“ ÷ 7 = 9 9/32″ .2857
“ ÷ 8 = 8 1/8″ .1250
“ ÷ 9 = 7 7/32″ .2222
“ ÷ 10 = 6 1/2″ .5000

66 ÷ 5 = 13 3/16″ .2000
“ ÷ 6 = 11″
“ ÷ 7 = 9 7/16″ .4286
“ ÷ 8 = 8 1/4″ .2500
“ ÷ 9 = 7 11/32″ .3333
“ ÷ 10 = 6 19/32″ .6000

67 ÷ 5 = 13 13/32″ .4000
“ ÷ 6 = 11 5/32″ .1667
“ ÷ 7 = 9 9/16″ .5714
“ ÷ 8 = 8 3/8″ .3750
“ ÷ 9 = 7 7/16″ .4444
“ ÷ 10 = 6 22/32″ .7000

68 ÷ 5 = 13 19/32″ .6000
“ ÷ 6 = 11 11/32″ .3333
“ ÷ 7 = 9 23/32″ .7143
“ ÷ 8 = 8 1/2″ .5000
“ ÷ 9 = 7 9/16″ .5556
“ ÷ 10 = 6 13/16″ .8000

69 ÷ 5 = 13 13/16″ .80
“ ÷ 6 = 11 1/2″ .5
“ ÷ 7 = 9 27/32″ .8571
“ ÷ 8 = 8 5/8″ .625
“ ÷ 9 = 7 21/32″ .6667
“ ÷ 10 = 6 29/32″ .90

70 ÷ 5 = 14″
“ ÷ 6 = 11 21/32″ .6667
“ ÷ 7 = 10″
“ ÷ 8 = 8 3/4″ .75
“ ÷ 9 = 7 25/32″ .7778
“ ÷ 10 = 7″

71 ÷ 5 = 14 3/16″ .20
“ ÷ 6 = 11 27/32″ .8333
“ ÷ 7 = 10 5/32″ .1429
“ ÷ 8 = 8 7/8″ .875
“ ÷ 9 = 7 7/8″ .8889
“ ÷ 10 = 7 3/32″ .10
“ ÷ 11 = 6 15/32″ .4545

72 ÷ 6 = 12″
“ ÷ 7 = 10 9/32″ .2857
“ ÷ 8 = 9″
“ ÷ 9 = 8″
“ ÷ 10 = 7 3/16″ .2000
“ ÷ 11 = 6 17/32″ .5455

73 ÷ 6 = 12 5/32″ .1667
“ ÷ 7 = 10 7/16″ .4286
“ ÷ 8 = 9 1/8″ .1250
“ ÷ 9 = 8 1/8″ .1111
“ ÷ 10 = 7 5/16″ .3000
“ ÷ 11 = 6 5/8″ .6364

74 ÷ 6 = 12 11/32″ .3333
“ ÷ 7 = 10 9/16″ .5714
“ ÷ 8 = 9 1/4″ .2500

74 ÷ 9 = 8 7/32" .2222
“ ÷ 10 = 7 13/32" .4000
“ ÷ 11 = 6 23/32" .7273

75 ÷ 6 = 12 1/2" .5000
“ ÷ 7 = 10 23/32" .7143
“ ÷ 8 = 9 3/8" .3750
“ ÷ 9 = 8 11/32" .3333
“ ÷ 10 = 7 1/2" .5000
“ ÷ 11 = 6 13/16" .8182

76 ÷ 6 = 12 21/32" .6667
“ ÷ 7 = 10 27/32" .8571
“ ÷ 8 = 9 1/2" .5000
“ ÷ 9 = 8 7/16" .4444
“ ÷ 10 = 7 19/32" .6000
“ ÷ 11 = 6 29/32" .9091

77 ÷ 6 = 12 27/32" .8333
“ ÷ 7 = 11"
“ ÷ 8 = 9 5/8" .6250
“ ÷ 9 = 8 9/16" .5556
“ ÷ 10 = 7 11/16" .7000
“ ÷ 11 = 7"

78 ÷ 6 = 13"
“ ÷ 7 = 11 5/32" .1429
“ ÷ 8 = 9 3/4" .7500
“ ÷ 9 = 8 21/32" .6667
“ ÷ 10 = 7 13/16" .8000
“ ÷ 11 = 7 3/32" .0909
“ ÷ 12 = 6 1/2" .5000

79 ÷ 6 = 13 5/32" .1667
“ ÷ 7 = 11 9/32" .2857
“ ÷ 8 = 9 7/8" .8750
“ ÷ 9 = 8 25/32" .7778
“ ÷ 10 = 7 29/32" .9000
“ ÷ 11 = 7 3/16" .1818
“ ÷ 12 = 6 19/32" .5833

80 ÷ 6 = 13 11/32" .3333
“ ÷ 7 = 11 7/16" .4286
“ ÷ 8 = 10"
“ ÷ 9 = 8 7/8" .8889
“ ÷ 10 = 8"
“ ÷ 11 = 7 9/32" .2727
“ ÷ 12 = 6 21/32" .6667

81 ÷ 6 = 13 1/2" .5000
“ ÷ 7 = 11 9/16" .5714
“ ÷ 8 = 10 1/8" .1250
“ ÷ 9 = 9"
81 ÷ 10 = 8 3/32" .1000
“ ÷ 11 = 7 3/8" .3636
“ ÷ 12 = 6 3/4" .7500

82 ÷ 6 = 13 21/32" .6667
“ ÷ 7 = 11 23/32" .7143
“ ÷ 8 = 10 1/4" .2500
“ ÷ 9 = 9 1/8" .1111
“ ÷ 10 = 8 3/16" .2000
“ ÷ 11 = 7 7/16" .4545
“ ÷ 12 = 6 27/32" .8333

83 ÷ 6 = 13 27/32" .8333
“ ÷ 7 = 11 27/32" .8571
“ ÷ 8 = 10 3/8" .3750
“ ÷ 9 = 9 7/32" .2222
“ ÷ 10 = 8 5/16" .3000
“ ÷ 11 = 7 17/32" .5455
“ ÷ 12 = 6 29/32" .9167

84 ÷ 7 = 12"
“ ÷ 8 = 10 1/2" .5000
“ ÷ 9 = 9 11/32" .3333
“ ÷ 10 = 8 13/32" .4000
“ ÷ 11 = 7 5/8" .6364
“ ÷ 12 = 7"

85 ÷ 7 = 12 5/32" .1429
“ ÷ 8 = 10 5/8" .6250
“ ÷ 9 = 9 7/16" .4444
“ ÷ 10 = 8 1/2" .5000
“ ÷ 11 = 7 23/32" .7273
“ ÷ 12 = 7 3/32" .0833
“ ÷ 13 = 6 17/32" .5385

86 ÷ 7 = 12 9/32" .2857
“ ÷ 8 = 10 3/4" .7500
“ ÷ 9 = 9 9/16" .5556
“ ÷ 10 = 8 19/32" .6000
“ ÷ 11 = 7 13/16" .8182
“ ÷ 12 = 7 5/32" .1667
“ ÷ 13 = 6 5/8" .6154

87 ÷ 7 = 12 7/16" .4286
“ ÷ 8 = 10 7/8" .8750
“ ÷ 9 = 9 21/32" .6667
“ ÷ 10 = 8 11/16" .7000
“ ÷ 11 = 7 29/32" .9091
“ ÷ 12 = 7 1/4" .2500
“ ÷ 13 = 6 11/16" .6923

88 ÷ 7 = 12 9/16" .5714
“ ÷ 8 = 11"

88 ÷ 9 = 9 25/32″ .7778
“ ÷ 10 = 8 13/16″ .8000
“ ÷ 11 = 8″
“ ÷ 12 = 7 11/32″ .3333
“ ÷ 13 = 6 25/32″ .7692

89 ÷ 7 = 12 23/32″ .7143
“ ÷ 8 = 11 1/8″ .1250
“ ÷ 9 = 9 7/8″ .8889
“ ÷ 10 = 8 29/32″ .9000
“ ÷ 11 = 8 3/32″ .0909
“ ÷ 12 = 7 13/32″ .4167
“ ÷ 13 = 6 27/32″ .8461

90 ÷ 7 = 12 27/32″ .8571
“ ÷ 8 = 11 1/4″ .2500
“ ÷ 9 = 10″
“ ÷ 10 = 9″
“ ÷ 11 = 8 3/16″ .1818
“ ÷ 12 = 7 1/2″ .5000
“ ÷ 13 = 6 15/16″ .9231

91 ÷ 7 = 13″
“ ÷ 8 = 11 3/8″ .3750
“ ÷ 9 = 10 1/8″ .1111
“ ÷ 10 = 9 3/32″ .1000
“ ÷ 11 = 8 9/32″ .2727
“ ÷ 12 = 7 19/32″ .5833
“ ÷ 13 = 7″

92 ÷ 7 = 13 5/32″ .1429
“ ÷ 8 = 11 1/2″ .5000
“ ÷ 9 = 10 7/32″ .2222
“ ÷ 10 = 9 3/16″ .2000
“ ÷ 11 = 8 3/8″ .3636
“ ÷ 12 = 7 21/32″ .6667
“ ÷ 13 = 7 1/16″ .0769
“ ÷ 14 = 6 9/16″ .5714

93 ÷ 7 = 13 9/32″ .2857
“ ÷ 8 = 11 5/8″ .6250
“ ÷ 9 = 10 11/32″ .3333
“ ÷ 10 = 9 5/16″ .3000
“ ÷ 11 = 8 15/32″ .4545
“ ÷ 12 = 7 3/4″ .7500
“ ÷ 13 = 7 5/32″ .1539
“ ÷ 14 = 6 21/32″ .6429

94 ÷ 7 = 13 7/16″ .4286
“ ÷ 8 = 11 3/4″ .7500
“ ÷ 9 = 10 7/16″ .4444
“ ÷ 10 = 9 13/32″ .4000
“ ÷ 11 = 8 17/32″ .5455

94 ÷ 12 = 7 27/32″ .8333
“ ÷ 13 = 7 7/32″ .2308
“ ÷ 14 = 6 23/32″ .7143

95 ÷ 7 = 13 9/16″ .5714
“ ÷ 8 = 11 7/8″ .8750
“ ÷ 9 = 10 9/16″ .5556
“ ÷ 10 = 9 1/2″ .5000
“ ÷ 11 = 8 5/8″ .6364
“ ÷ 12 = 7 29/32″ .9167
“ ÷ 13 = 7 5/16″ .3077
“ ÷ 14 = 6 25/32″ .7857

96 ÷ 8 = 12″
“ ÷ 9 = 10 21/32″ .6667
“ ÷ 10 = 9 19/32″ .6000
“ ÷ 11 = 8 23/32″ .7273
“ ÷ 12 = 8″
“ ÷ 13 = 7 3/8″ .3846
“ ÷ 14 = 6 27/32″ .8571

97 ÷ 8 = 12 1/8″ .1250
“ ÷ 9 = 10 25/32″ .7778
“ ÷ 10 = 9 11/16″ .7000
“ ÷ 11 = 8 13/16″ 8182
“ ÷ 12 = 8 3/32″ .0833
“ ÷ 13 = 7 15/32″ .4615
“ ÷ 14 = 6 15/16″ .9286

98 ÷ 8 = 12 1/4″ .2500
“ ÷ 9 = 10 7/8″ .8889
“ ÷ 10 = 9 13/16″ .8000
“ ÷ 11 = 8 29/32″ .9091
“ ÷ 12 = 8 5/32″ .1667
“ ÷ 13 = 7 17/32″ .5385
“ ÷ 14 = 7″

99 ÷ 8 = 12 3/8″ .3750
“ ÷ 9 = 11″
“ ÷ 10 = 9 29/32″ .90
“ ÷ 11 = 9″
“ ÷ 12 = 8 1/4″ .2500
“ ÷ 13 = 7 5/8″ .6154
“ ÷ 14 = 7 1/16″ .0714
“ ÷ 15 = 6 19/32″ .6000

100 ÷ 8 = 12 1/2″ .5000
“ ÷ 9 = 11 1/8″ .1111
“ ÷ 10 = 10″
“ ÷ 11 = 9 3/32″ .0909
“ ÷ 12 = 8 11/32″ .3333
“ ÷ 13 = 7 25/32″ .6923

100 ÷ 14 = 7 5/32" .1429
“ ÷ 15 = 6 21/32" .6667

101 ÷ 8 = 12 5/8" .6250
“ ÷ 9 = 11 7/32" .2222
“ ÷ 10 = 10 3/32" .1000
“ ÷ 11 = 9 3/16" .1818
“ ÷ 12 = 8 13/32" .4167
“ ÷ 13 = 7 25/32" .7692
“ ÷ 14 = 7 7/32" .2143
“ ÷ 15 = 6 23/32" .7333

102 ÷ 8 = 12 3/4" .7500
“ ÷ 9 = 11 11/32" .3333
“ ÷ 10 = 10 3/16" .2000
“ ÷ 11 = 9 9/32" .2727
“ ÷ 12 = 8 1/2" .5000
“ ÷ 13 = 7 27/32" .8462
“ ÷ 14 = 7 9/32" .2857
“ ÷ 15 = 6 13/16" .8000

103 ÷ 8 = 12 7/8" .8750
“ ÷ 9 = 11 7/16" .4444
“ ÷ 10 = 10 5/16" .3000
“ ÷ 11 = 9 3/8" .3636
“ ÷ 12 = 8 19/32" .5833
“ ÷ 13 = 7 15/16" .9231
“ ÷ 14 = 7 11/32" .3571
“ ÷ 15 = 6 7/8" .8667

104 ÷ 8 = 13"
“ ÷ 9 = 11 9/16" .5556
“ ÷ 10 = 10 13/32" .4000
“ ÷ 11 = 9 15/32" .4545
“ ÷ 12 = 8 21/32" .6667
“ ÷ 13 = 8"
“ ÷ 14 = 7 7/16" .4286
“ ÷ 15 = 6 15/16" .9333

105 ÷ 8 = 13 1/8" .1250
“ ÷ 9 = 11 21/32" .6667
“ ÷ 10 = 10 1/2" .5000
“ ÷ 11 = 9 17/32" .5454
“ ÷ 12 = 8 3/4" .7500
“ ÷ 13 = 8 1/16" .0769
“ ÷ 14 = 7 1/2" .500
“ ÷ 15 = 7"

106 ÷ 8 = 13 1/4" .2500
“ ÷ 9 = 11 25/32" .7778
“ ÷ 10 = 10 19/32" .6000
“ ÷ 11 = 9 5/8" .6364

106 ÷ 12 = 8 27/32" .8333
“ ÷ 13 = 8 5/32" .1539
“ ÷ 14 = 7 9/16" .5714
“ ÷ 15 = 7 1/16" .0667
“ ÷ 16 = 6 5/8" .6250

107 ÷ 8 = 13 3/8" .3750
“ ÷ 9 = 11 7/8" .8889
“ ÷ 10 = 10 11/16" .7000
“ ÷ 11 = 9 23/32" .7273
“ ÷ 12 = 8 29/32" .9167
“ ÷ 13 = 8 7/32" .2308
“ ÷ 14 = 7 21/32" .6429
“ ÷ 15 = 7 1/8" .1333
“ ÷ 16 = 6 11/16" .6875

108 ÷ 9 = 12"
“ ÷ 10 = 10 13/16" .8000
“ ÷ 11 = 9 13/16" .8182
“ ÷ 12 = 9"
“ ÷ 13 = 8 5/16" .3077
“ ÷ 14 = 7 23/32" .7143
“ ÷ 15 = 7 3/16" .2000
“ ÷ 16 = 6 3/4" .7500

109 ÷ 9 = 12 1/8" .1111
“ ÷ 10 = 10 29/32" .9000
“ ÷ 11 = 9 29/32" .9091
“ ÷ 12 = 9 3/32" .0833
“ ÷ 13 = 8 3/8" .3846
“ ÷ 14 = 7 25/32" .7857
“ ÷ 15 = 7 9/32" .2667
“ ÷ 16 = 6 13/16" .8125

110 ÷ 9 = 12 7/32" .2222
“ ÷ 10 = 11"
“ ÷ 11 = 10"
“ ÷ 12 = 9 5/32" .1667
“ ÷ 13 = 8 15/32" .4615
“ ÷ 14 = 7 27/32" .8571
“ ÷ 15 = 7 11/32" .3333
“ ÷ 16 = 6 7/8" .8750

111 ÷ 9 = 12 11/32" .3333
“ ÷ 10 = 11 3/32" .1000
“ ÷ 11 = 10 3/32" .0909
“ ÷ 12 = 9 1/4" .2500
“ ÷ 13 = 8 17/32" .5385
“ ÷ 14 = 7 15/16" .9286
“ ÷ 15 = 7 13/32" .4000
“ ÷ 16 = 6 15/16" .9375

112 ÷ 9 = 12 7/16" .4444
" ÷ 10 = 11 3/16" .2000
" ÷ 11 = 10 3/16" .1818
" ÷ 12 = 9 11/32" .3333
" ÷ 13 = 8 5/8" .6154
" ÷ 14 = 8"
" ÷ 15 = 7 15/32" .4667
" ÷ 16 = 7"

113 ÷ 9 = 12 9/16" .5556
" ÷ 10 = 11 5/16" .3000
" ÷ 11 = 10 9/32" .2727
" ÷ 12 = 9 13/32" .4167
" ÷ 13 = 8 11/16" .6923
" ÷ 14 = 8 1/16" .0714
" ÷ 15 = 7 17/32" .5333
" ÷ 16 = 7 1/16" .0625
" ÷ 17 = 6 21/32" .6471

114 ÷ 9 = 12 21/32" .6667
" ÷ 10 = 11 13/32" .4000
" ÷ 11 = 10 3/8" .3750
" ÷ 12 = 9 1/2" .5000
" ÷ 13 = 8 25/32" .7692
" ÷ 14 = 8 5/32" .1429
" ÷ 15 = 7 19/32" .6000
" ÷ 16 = 7 1/8" .1250
" ÷ 17 = 6 23/32" .7059

115 ÷ 9 = 12 25/32" .7778
" ÷ 10 = 11 1/2" .5000
" ÷ 11 = 10 15/32" .4545
" ÷ 12 = 9 19/32" .5833
" ÷ 13 = 8 27/32" .8462
" ÷ 14 = 8 7/32" .2143
" ÷ 15 = 7 21/32" .6667
" ÷ 16 = 7 3/16" .1875
" ÷ 17 = 6 3/4" .7647

116 ÷ 9 = 12 7/8" .8889
" ÷ 10 = 11 19/32" .6000
" ÷ 11 = 10 17/32" .5455
" ÷ 12 = 9 21/32" .6667
" ÷ 13 = 8 15/16" .9231
" ÷ 14 = 8 9/32" .2857
" ÷ 15 = 7 23/32" .7333
" ÷ 16 = 7 1/4" .2500
" ÷ 17 = 6 13/16" .8235

117 ÷ 9 = 13"
" ÷ 10 = 11 11/16" .7000
" ÷ 11 = 10 5/8" .6364

117 ÷ 12 = 9 3/4" .7500
" ÷ 13 = 9"
" ÷ 14 = 8 11/32" .3571
" ÷ 15 = 7 13/16" .8000
" ÷ 16 = 7 5/16" .3125
" ÷ 17 = 6 7/8" .8824

118 ÷ 9 = 13 1/8" .1111
" ÷ 10 = 11 13/16" .8000
" ÷ 11 = 10 23/32" .7273
" ÷ 12 = 9 27/32" .8333
" ÷ 13 = 9 1/16" .0769
" ÷ 14 = 8 7/16" .4286
" ÷ 15 = 7 7/8" .8667
" ÷ 16 = 7 3/8" .3750
" ÷ 17 = 6 15/16" .9412

119 ÷ 9 = 13 7/32" .2222
" ÷ 10 = 11 29/32" .9000
" ÷ 11 = 10 13/16" .8182
" ÷ 12 = 9 29/32" .9167
" ÷ 13 = 9 5/32" .1539
" ÷ 14 = 8 1/2" .5000
" ÷ 15 = 7 15/16" .9333
" ÷ 16 = 7 7/16" .4375
" ÷ 17 = 7"

120 ÷ 10 = 12"
" ÷ 11 = 10 29/32" .9091
" ÷ 12 = 10"
" ÷ 13 = 9 7/32" .2308
" ÷ 14 = 8 9/16" .5714
" ÷ 15 = 8"
" ÷ 16 = 7 1/2" .5000
" ÷ 17 = 7 1/16" .0588
" ÷ 18 = 6 21/32" .6667

121 ÷ 10 = 12 3/32" .1000
" ÷ 11 = 11"
" ÷ 12 = 10 3/32" .0833
" ÷ 13 = 9 5/16" .3077
" ÷ 14 = 8 21/32" .6429
" ÷ 15 = 8 1/16" .0667
" ÷ 16 = 7 9/16" .5625
" ÷ 17 = 7 1/8" .1176
" ÷ 18 = 6 23/32" .7222

122 ÷ 10 = 12 3/16" .2000
" ÷ 11 = 11 3/32" .0909
" ÷ 12 = 10 5/32" .1667
" ÷ 13 = 9 3/8" .3846
" ÷ 14 = 8 23/32" .7143

122 ÷ 15 = 8 1/8" .1333
“ ÷ 16 = 7 5/8" .6250
“ ÷ 17 = 7 3/16" .1765
“ ÷ 18 = 6 25/32" .7778

123 ÷ 10 = 12 5/16" .3000
“ ÷ 11 = 11 3/16" .1818
“ ÷ 12 = 10 1/4" .2500
“ ÷ 13 = 9 15/32" .4615
“ ÷ 14 = 8 25/32" .7857
“ ÷ 15 = 8 3/16" .2000
“ ÷ 16 = 7 11/16" .6875
“ ÷ 17 = 7 1/4" .2353
“ ÷ 18 = 6 27/32" .8333

124 ÷ 10 = 12 13/32" .4000
“ ÷ 11 = 11 9/32" .2727
“ ÷ 12 = 10 11/32" .3333
“ ÷ 13 = 9 17/32" .5385
“ ÷ 14 = 8 27/32" .8571
“ ÷ 15 = 8 9/32" .2667
“ ÷ 16 = 7 3/4" .7500
“ ÷ 17 = 7 9/32" .2941
“ ÷ 18 = 6 7/8" .8889

125 ÷ 10 = 12 1/2" .5000
“ ÷ 11 = 11 3/8" .3636
“ ÷ 12 = 10 13/32" .4167
“ ÷ 13 = 9 5/8" .6354
“ ÷ 14 = 8 15/16" .9286
“ ÷ 15 = 8 11/32" .3333
“ ÷ 16 = 7 13/16" .8125
“ ÷ 17 = 7 11/32" .3529
“ ÷ 18 = 6 15/16" .9444

126 ÷ 10 = 12 19/32" .6000
“ ÷ 11 = 11 15/32" .4545
“ ÷ 12 = 10 1/2" .5000
“ ÷ 13 = 9 11/16" .6923
“ ÷ 14 = 9"
“ ÷ 15 = 8 13/32" .4000
“ ÷ 16 = 7 7/8" .8750
“ ÷ 17 = 7 13/32" .4118
“ ÷ 18 = 7"

127 ÷ 10 = 12 11/16" .7000
“ ÷ 11 = 11 17/32" .5455
“ ÷ 12 = 10 19/32" .5833
“ ÷ 13 = 9 25/[illegible] .7692
“ ÷ 14 = 9 1/16" .0714
“ ÷ 15 = 8 15/32" .4667
“ ÷ 16 = 7 15/16" .9375

127 ÷ 17 = 7 15/32" .4706
“ ÷ 18 = 7 1/16" .0556
“ ÷ 19 = 6 11/16" .6842

128 ÷ 10 = 12 13/16" .8000
“ ÷ 11 = 11 5/8" .6364
“ ÷ 12 = 10 21/32" .6667
“ ÷ 13 = 9 27/32" .8462
“ ÷ 14 = 9 5/32" .1429
“ ÷ 15 = 8 17/32" .5333
“ ÷ 16 = 8"
“ ÷ 17 = 7 17/32" .5294
“ ÷ 18 = 7 1/8" .1111
“ ÷ 19 = 6 3/4" .7368

129 ÷ 10 = 12 29/32" .9000
“ ÷ 11 = 11 23/32" .7273
“ ÷ 12 = 10 3/4" .7500
“ ÷ 13 = 9 15/16" .9231
“ ÷ 14 = 9 7/32" .2143
“ ÷ 15 = 8 19/32" .6000
“ ÷ 16 = 8 1/16" .0625
“ ÷ 17 = 7 19/32" .5882
“ ÷ 18 = 7 5/32" .1667
“ ÷ 19 = 6 25/32" .7895

130 ÷ 10 = 13"
“ ÷ 11 = 11 13/16" .8182
“ ÷ 12 = 10 27/32" .8333
“ ÷ 13 = 10"
“ ÷ 14 = 9 9/32" .2857
“ ÷ 15 = 8 21/32" .6667
“ ÷ 16 = 8 1/8" .1250
“ ÷ 17 = 7 21/32" .6471
“ ÷ 18 = 7 7/32" .2222
“ ÷ 19 = 6 27/32" .8421

131 ÷ 10 = 13 3/32" .1000
“ ÷ 11 = 11 29/32" .9091
“ ÷ 12 = 10 29/32" .9167
“ ÷ 13 = 10 1/16" .0769
“ ÷ 14 = 9 11/32" .3571
“ ÷ 15 = 8 23/32" .7333
“ ÷ 16 = 8 3/16" .1875
“ ÷ 17 = 7 23/32" .7059
“ ÷ 18 = 7 9/32" .2778
“ ÷ 19 = 6 29/32" .8947

132 ÷ 11 = 12"
“ ÷ 12 = 11"
“ ÷ 13 = 10 5/32" .1539

132 ÷ 14 = 9 7/16" .4286
“ ÷ 15 = 8 13/16" .8000
“ ÷ 16 = 8 1/4" .2500
“ ÷ 17 = 7 3/4" 7647
“ ÷ 18 = 7 11/32" .3333
“ ÷ 19 = 6 15/16" .9474

133 ÷ 11 = 12 3/32" .0909
“ ÷ 12 = 11 1/16" .0833
“ ÷ 13 = 10 7/32" .2308
“ ÷ 14 = 9 1/2" .5000
“ ÷ 15 = 8 7/8" .8667
“ ÷ 16 = 8 5/16" .3125
“ ÷ 17 = 7 13/16" .8235
“ ÷ 18 = 7 3/8" .3889
“ ÷ 19 = 7"

134 ÷ 11 = 12 3/16" .1818
“ ÷ 12 = 11 5/32" .1667
“ ÷ 13 = 10 5/16" .3077
“ ÷ 14 = 9 9/16" .5714
“ ÷ 15 = 8 15/16" .9333
“ ÷ 16 = 8 3/8" .3750
“ ÷ 17 = 7 7/8" .8824
“ ÷ 18 = 7 7/16" .4444
“ ÷ 19 = 7 1/16" .0526
“ ÷ 20 = 6 11/16" .7000

135 ÷ 11 = 12 9/32" .2727
“ ÷ 12 = 11 1/4" .2500
“ ÷ 13 = 10 3/8" .3846
“ ÷ 14 = 9 21/32" .6429
“ ÷ 15 = 9"
“ ÷ 16 = 8 7/16" .4375
“ ÷ 17 = 7 15/16" .9412
“ ÷ 18 = 7 1/2" .5000
“ ÷ 19 = 7 3/32" .1053
“ ÷ 20 = 6 3/4" .7500

136 ÷ 11 = 12 3/8" .3636
“ ÷ 12 = 11 11/32" .3333
“ ÷ 13 = 10 15/32" .4615
“ ÷ 14 = 9 23/32" .7143
“ ÷ 15 = 9 1/16" .0667
“ ÷ 16 = 8 1/2" .5000
“ ÷ 17 = 8"
' ÷ 18 = 7 9/16" .5556
“ ÷ 19 = 7 5/32" .1579
“ ÷ 20 = 6 13/16" .8000

137 ÷ 11 = 12 15/32" .4545
“ ÷ 12 = 11 13/32" .4167
137 ÷ 13 = 10 17/32" .5385
“ ÷ 14 = 9 25/32" .7857
“ ÷ 15 = 9 1/8" .1333
“ ÷ 16 = 8 9/16" .5625
“ ÷ 17 = 8 1/16" .0588
“ ÷ 18 = 7 5/8" .6111
“ ÷ 19 = 7 7/32" .2105
“ ÷ 20 = 6 27/32" .8500

138 ÷ 11 = 12 17/32" .5455
“ ÷ 12 = 11 1/2" .5000
“ ÷ 13 = 10 5/8" .6154
“ ÷ 14 = 9 27/32" .8571
“ ÷ 15 = 9 3/16" .2000
“ ÷ 16 = 8 5/8" .6250
“ ÷ 17 = 8 1/8" .1176
“ ÷ 18 = 7 21/32" .6667
“ ÷ 19 = 7 1/4" .2632
“ ÷ 20 = 6 29/32" .9000

139 ÷ 11 = 12 5/8" .6364
“ ÷ 12 = 11 19/32" .5833
“ ÷ 13 = 10 11/16" .6923
“ ÷ 14 = 9 15/16" .9286
“ ÷ 15 = 9 9/32" .2667
“ ÷ 16 = 8 11/16" .6875
“ ÷ 17 = 8 3/16" .1765
“ ÷ 18 = 7 23/32" .7222
“ ÷ 19 = 7 5/16" .3158
“ ÷ 20 = 6 15/16" .9500

140 ÷ 11 = 12 23/32" .7273
“ ÷ 12 = 11 21/32" .6667
“ ÷ 13 = 10 25/32" .7692
“ ÷ 14 = 10"
“ ÷ 15 = 9 11/32" .3333
“ ÷ 16 = 8 3/4" ..75
“ ÷ 17 = 8 1/4" .2353
“ ÷ 18 = 7 25/32" .7778
“ ÷ 19 = 7 3/8" .3684
“ ÷ 20 = 7"

141 ÷ 11 = 12 13/16" .8182
“ ÷ 12 = 11 3/4" .7500
“ ÷ 13 = 10 27/32" .8462
“ ÷ 14 = 10 1/16" .0714
“ ÷ 15 = 9 13/32" .4000
“ ÷ 16 = 8 13/16" .8125
“ ÷ 17 = 8 9/32" .2941
“ ÷ 18 = 7 27/32" .8333
“ ÷ 19 = 7 13/32" .4211

141 ÷ 20 = 7 1/16" .0500
" ÷ 21 = 6 23/32" .7143

142 ÷ 11 = 12 29/32" .9091
" ÷ 12 = 11 27/32" .8333
" ÷ 13 = 10 15/16" .9231
" ÷ 14 = 10 5/32" .1429
" ÷ 15 = 9 15/32" .4667
" ÷ 16 = 8 7/8" .8750
" ÷ 17 = 8 11/32" .3529
" ÷ 18 = 7 14/16" .8889
" ÷ 19 = 7 15/32" .4737
" ÷ 20 = 7 3/32" .1000
" ÷ 21 = 6 3/4" .7619

143 ÷ 11 = 13"
" ÷ 12 = 11 29/32" .9167
" ÷ 13 = 11"
" ÷ 14 = 10 7/32" .2143
" ÷ 15 = 9 17/32" .5333
" ÷ 16 = 8 15/16" .9375
" ÷ 17 = 8 13/32" .4118
" ÷ 18 = 7 15/16" .9444
" ÷ 19 = 7 17/32" .5263
" ÷ 20 = 7 5/32" .15
" ÷ 21 = 6 13/16" .8095

144 ÷ 12 = 12"
" ÷ 13 = 11 1/16" .0769
" ÷ 14 = 10 9/32" .2857
" ÷ 15 = 9 19/32" .6
" ÷ 16 = 9"
" ÷ 17 = 8 15/32" .4706
" ÷ 18 = 8"
" ÷ 19 = 7 19/32" .5789
" ÷ 20 = 7 3/16" .2
" ÷ 21 = 6 27/32" .8571

145 ÷ 12 = 12 3/32" .0833
" ÷ 13 = 11 5/32" .1539
" ÷ 14 = 10 11/32" .3571
" ÷ 15 = 9 21/32" .6667
" ÷ 16 = 9 1/16" .0625
" ÷ 17 = 8 17/32" .5294
" ÷ 18 = 8 1/16" .0556
" ÷ 19 = 7 5/8" .6316
" ÷ 20 = 7 1/4" .25
" ÷ 21 = 6 29/32" .9048

146 ÷ 12 = 12 5/32" .1667
" ÷ 13 = 11 7/32" .2308
" ÷ 14 = 10 7/16" .4286
146 ÷ 15 = 9 23/32" .7333
" ÷ 16 = 9 1/8" .125
" ÷ 17 = 8 19/32" .5882
" ÷ 18 = 8 1/8" .1111
" ÷ 19 = 7 11/16" .6842
" ÷ 20 = 7 5/16" .30
" ÷ 21 = 6 15/16" .9524

147 ÷ 12 = 12 1/4" .25
" ÷ 13 = 11 10/32" .3077
" ÷ 14 = 10 1/2" .5
" ÷ 15 = 9 13/16" .8
" ÷ 16 = 9 3/16" .1875
" ÷ 17 = 8 21/32" .6471
" ÷ 18 = 8 5/32" .1667
" ÷ 19 = 7 3/4" .7368
" ÷ 20 = 7 11/32" .35
" ÷ 21 = 7"

148 ÷ 12 = 12 11/32" .3333
" ÷ 13 = 11 12/32" .3846
" ÷ 14 = 10 18/32" .5714
" ÷ 15 = 9 28/32" .8667
" ÷ 16 = 9 1/4" .25
" ÷ 17 = 8 23/32" .7059
" ÷ 18 = 8 7/32" .2222
" ÷ 19 = 7 25/32" .7895
" ÷ 20 = 7 13/32" .40
" ÷ 21 = 7 1/16" .0476
" ÷ 22 = 6 23/32" .7273

149 ÷ 12 = 12 13/32" .4167
" ÷ 13 = 11 15/32" .4615
" ÷ 14 = 10 21/32" .6429
" ÷ 15 = 9 15/16" .9333
" ÷ 16 = 9 5/16" .3125
" ÷ 17 = 8 3/4" .7647
" ÷ 18 = 8 9/32" .2778
" ÷ 19 = 7 27/32" .8421
" ÷ 20 = 7 7/16" .45
" ÷ 21 = 7 3/32" .0952
" ÷ 22 = 6 25/32" .7727

150 ÷ 12 = 12 1/2" .5000
" ÷ 13 = 11 17/32" .5385
" ÷ 14 = 10 23/32" .7143
" ÷ 15 = 10"
" ÷ 16 = 9 3/8" .3750
" ÷ 17 = 8 13/16" .8235
" ÷ 18 = 8 11/32" .3333
" ÷ 19 = 7 29/32" .8947

150 ÷ 20 = 7 1/2" .5000
" ÷ 21 = 7 1/8" .1429
" ÷ 22 = 6 13/16" .8182

151 ÷ 12 = 12 19/32" .5833
" ÷ 13 = 11 5/8" .6154
" ÷ 14 = 10 25/32" .7857
" ÷ 15 = 10 1/16" .0667
" ÷ 16 = 9 7/16" .4375
" ÷ 17 = 8 7/8" .8824
" ÷ 18 = 8 3/8" .3889
" ÷ 19 = 7 15/16" .9474
" ÷ 20 = 7 9/16" .5500
" ÷ 21 = 7 3/16" .1905
" ÷ 22 = 6 7/8" .8636

152 ÷ 12 = 12 21/32" .6667
" ÷ 13 = 11 11/16" .6923
" ÷ 14 = 10 27/32" .8571
" ÷ 15 = 10 1/8" .1333
" ÷ 16 = 9 1/2" .5000
" ÷ 17 = 8 15/16" .9412
" ÷ 18 = 8 7/16" .4444
" ÷ 19 = 8"
" ÷ 20 = 7 19/32" .6000
" ÷ 21 = 7 1/4" .2381
" ÷ 22 = 6 29/32" .9091

153 ÷ 12 = 12 23/32" .7500
" ÷ 13 = 11 25/32" .7692
" ÷ 14 = 10 15/16" .9286
" ÷ 15 = 10 3/16" .2000
" ÷ 16 = 9 9/16" .5625
" ÷ 17 = 9"
" ÷ 18 = 8 1/2" .5000
" ÷ 19 = 8 1/16" .0526
" ÷ 20 = 7 21/32" .6500
" ÷ 21 = 7 9/32" .2857
" ÷ 22 = 6 31/32" .9545

154 ÷ 12 = 12 27/32" .8333
" ÷ 13 = 11 27/32" .8462
" ÷ 14 = 11"
" ÷ 15 = 10 9/32" .2667
" ÷ 16 = 9 5/8" .6250
" ÷ 17 = 9 1/16" .0588
" ÷ 18 = 8 9/16" .5556
" ÷ 19 = 8 3/32" .1053
" ÷ 20 = 7 11/16" .7000
" ÷ 21 = 7 11/32" .3333
" ÷ 22 = 7"

155 ÷ 12 = 12 29/32" .9167
" ÷ 13 = 11 15/16" .9231
" ÷ 14 = 11 1/16" .0714
" ÷ 15 = 10 11/32" .3333
" ÷ 16 = 9 11/16" .6875
" ÷ 17 = 9 1/8" .1176
" ÷ 18 = 8 5/8" .6111
" ÷ 19 = 8 5/32" .1579
" ÷ 20 = 7 3/4" .7500
" ÷ 21 = 7 3/8" .3810
" ÷ 22 = 7 1/32" .0455
" ÷ 23 = 6 3/4" .7391

156 ÷ 13 = 12"
" ÷ 14 = 11 5/32" .1429
" ÷ 15 = 10 13/32" .4000
" ÷ 16 = 9 3/4" .7500
" ÷ 17 = 9 6/32" .1765
" ÷ 18 = 8 21/32" .6667
" ÷ 19 = 8 7/32" .2105
" ÷ 20 = 7 13/16" .8000
" ÷ 21 = 7 7/16" .4286
" ÷ 22 = 7 3/32" .0909
" ÷ 23 = 6 25/32" .7826

157 ÷ 13 = 12 1/16" .0769
" ÷ 14 = 11 7/32" .2143
" ÷ 15 = 10 15/32" .4667
" ÷ 16 = 9 13/16" .8125
" ÷ 17 = 9 1/4" .2353
" ÷ 18 = 8 23/32" .7222
" ÷ 19 = 8 1/4" .2632
" ÷ 20 = 7 27/32" .8500
" ÷ 21 = 7 15/32" .4762
" ÷ 22 = 7 1/8" .1364
" ÷ 23 = 6 13/16" .8261

158 ÷ 11 = 14 3/8" .3636
" ÷ 12 = 13 5/32" .1667
" ÷ 13 = 12 5/32" .1539
" ÷ 14 = 11 9/32" .2857
" ÷ 15 = 10 17/32" .5333
" ÷ 16 = 9 7/8" .8750
" ÷ 17 = 9 9/32" .2941
" ÷ 18 = 8 25/32" .7778
" ÷ 19 = 8 5/16" .3158
" ÷ 20 = 7 29/32" .9000
" ÷ 21 = 7 17/32" .5238
" ÷ 22 = 7 3/16" .1818
" ÷ 23 = 6 7/8" .8696

159 ÷ 11 = 14 15/32" .4545
" ÷ 12 = 13 1/4" .2500
" ÷ 13 = 12 7/32" .2308
" ÷ 14 = 11 11/32" .3571
" ÷ 15 = 10 19/32" .6000
" ÷ 16 = 9 15/16" .9375
" ÷ 17 = 9 11/32" .3529
" ÷ 18 = 8 27/32" .8333
" ÷ 19 = 8 3/8" .3684
" ÷ 20 = 7 15/16" .9500
" ÷ 21 = 7 9/16" .5714
" ÷ 22 = 7 7/32" .2273
" ÷ 23 = 6 29/32" .9130

160 ÷ 11 = 14 17/32" .5455
" ÷ 12 = 13 11/32" .3333
" ÷ 13 = 12 5/16" .3077
" ÷ 14 = 11 7/16" .4286
" ÷ 15 = 10 21/32" .6667
" ÷ 16 = 10"
" ÷ 17 = 9 13/32" .4118
" ÷ 18 = 8 7/8" .8889
" ÷ 19 = 8 13/32" .4211
" ÷ 20 = 8"
" ÷ 21 = 7 5/8" .6190
" ÷ 22 = 7 9/32" .2727
" ÷ 23 = 6 31/32" .9565

161 ÷ 11 = 14 5/8" .6364
" ÷ 12 = 13 13/32" .4167
" ÷ 13 = 12 3/8" .3846
" ÷ 14 = 11 1/2" .5000
" ÷ 15 = 10 23/32" .7333
" ÷ 16 = 10 1/16" .0625
" ÷ 17 = 9 15/32" .4706
" ÷ 18 = 8 15/16" .9444
" ÷ 19 = 8 15/32" .4737
" ÷ 20 = 8 1/16" .05
" ÷ 21 = 7 21/32" .6667
" ÷ 22 = 7 5/16" .3182
" ÷ 23 = 7"

162 ÷ 13 = 12 15/32" .4615
" ÷ 14 = 11 9/16" .5714
" ÷ 15 = 10 13/16" .8000
" ÷ 16 = 10 1/8" .1250
" ÷ 17 = 9 17/32" .5294
" ÷ 18 = 9"
" ÷ 19 = 8 17/32" .5263
" ÷ 20 = 8 3/32" .1000
" ÷ 21 = 7 23/32" .7143

162 ÷ 22 = 7 3/8" .3636
" ÷ 23 = 7 1/32" .0435
" ÷ 24 = 6 3/4" .7500

163 ÷ 13 = 12 17/32" .5385
" ÷ 14 = 11 21/32" .6429
" ÷ 15 = 10 7/8" .8667
" ÷ 16 = 10 3/16" .1875
" ÷ 17 = 9 19/32" .5882
" ÷ 18 = 9 1/16" .0556
" ÷ 19 = 8 19/32" .5789
" ÷ 20 = 8 5/32" .1500
" ÷ 21 = 7 3/4" .7619
" ÷ 22 = 7 13/32" .4091
" ÷ 23 = 7 3/32" .0867
" ÷ 24 = 6 25/32" .7917

164 ÷ 13 = 12 5/8" .6154
" ÷ 14 = 11 23/32" .7143
" ÷ 15 = 10 15/16" .9333
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" ÷ 17 = 9 21/32" .6471
" ÷ 18 = 9 3/32" .1111
" ÷ 19 = 8 5/8" .6316
" ÷ 20 = 8 3/16" .2000
" ÷ 21 = 7 13/16" .8095
" ÷ 22 = 7 15/32" .4545
" ÷ 23 = 7 1/8" .1304
" ÷ 24 = 6 27/32" .8333

165 ÷ 13 = 12 11/16" .6923
" ÷ 14 = 11 25/32" .7857
" ÷ 15 = 11"
" ÷ 16 = 10 5/16" .3125
" ÷ 17 = 9 23/32" .7059
" ÷ 18 = 9 5/32" .1667
" ÷ 19 = 8 11/16" .6842
" ÷ 20 = 8 1/4" .2500
" ÷ 21 = 7 27/32" .8571
" ÷ 22 = 7 1/2" .5000
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" ÷ 24 = 6 7/8" .875

166 ÷ 13 = 12 25/32" .7692
" ÷ 14 = 11 27/32" .8571
" ÷ 15 = 11 1/16" .0667
" ÷ 16 = 10 3/8" .3750
" ÷ 17 = 9 3/4" .7647
" ÷ 18 = 9 7/32" .2222
" ÷ 19 = 8 3/4" .7368
" ÷ 20 = 8 5/16" .3000
" ÷ 21 = 7 29/32" .9048

166 ÷ 22 = 7 17/32" .5455
" ÷ 23 = 7 7/32" .2174
" ÷ 24 = 6 29/32" .9167

167 ÷ 13 = 12 27/32" .8462
" ÷ 14 = 11 15/16" .9286
" ÷ 15 = 11 1/8" .1333
" ÷ 16 = 10 7/16" .4375
" ÷ 17 = 9 13/16" .8235
" ÷ 18 = 9 9/32" .2778
" ÷ 19 = 8 25/32" .7895
" ÷ 20 = 8 11/32" .3500
" ÷ 21 = 7 15/16" .9524
" ÷ 22 = 7 19/32" .5909
" ÷ 23 = 7 1/4" .2609
" ÷ 24 = 6 31/32" .9583

168 ÷ 13 = 12 15/16" .9231
" ÷ 14 = 12"
" ÷ 15 = 11 3/16" .2000
" ÷ 16 = 10 1/2" .5000
" ÷ 17 = 9 7/8" .8824
" ÷ 18 = 9 11/32" .3333
" ÷ 19 = 8 27/32" .8421
" ÷ 20 = 8 13/32" .4000
" ÷ 21 = 8"
" ÷ 22 = 7 5/8" .6364
" ÷ 23 = 7 5/16" .3043
" ÷ 24 = 7"
" ÷ 25 = 6 23/32" .7200